The Welding Engineer

Founded by L. B. Mackenzie, 1916

FEBRUARY, 1925 VOL. 10. No. 2

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OXYGEN buyers should specify the percentage of purity in their contracts, and insist that deliveries are continuously up to specifications.

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ANYTHING and EVERYTHING for OXYACETYLENE WELDING and CUTTING

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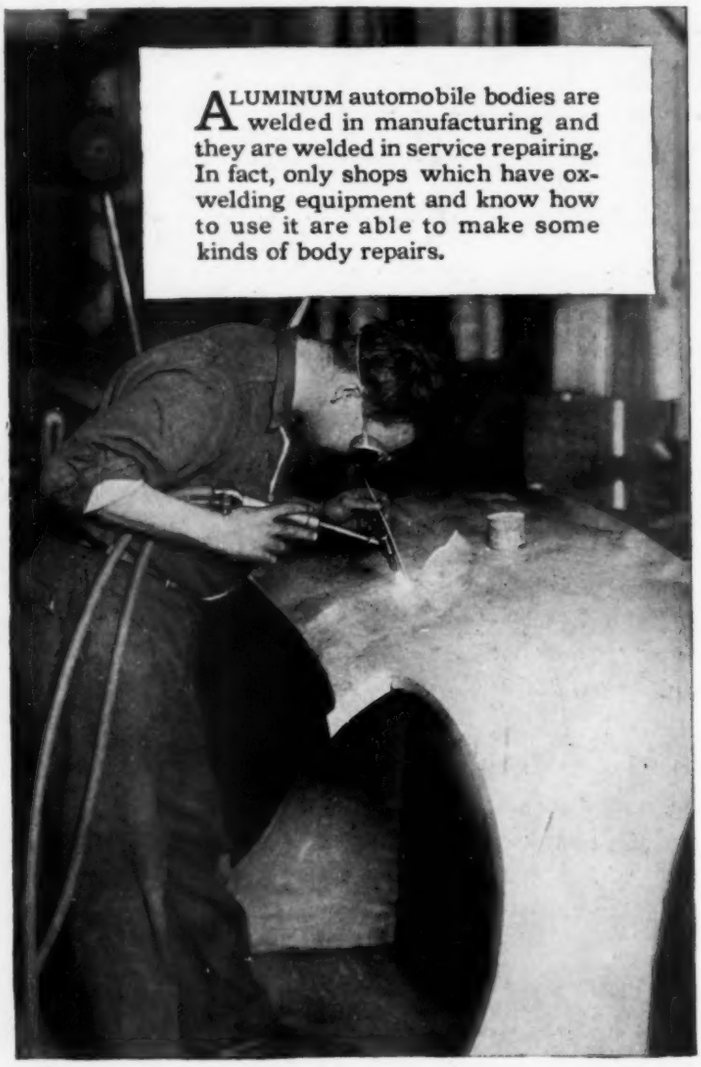
What do you get when you buy Oxweld apparatus?


ALUMINUM automobile bodies are welded in manufacturing and they are welded in service repairing. In fact, only shops which have oxwelding equipment and know how to use it are able to make some kinds of body repairs.

1. When you buy Oxweld apparatus you get the apparatus you pay for

All Oxweld apparatus has back of it thoroughly modern factories, an engineering department, and research laboratories. Factories, engineers, and laboratories have but one objective: to design and make the best apparatus possible.

2. When you buy Oxweld apparatus you get profits and economies which you do not pay for

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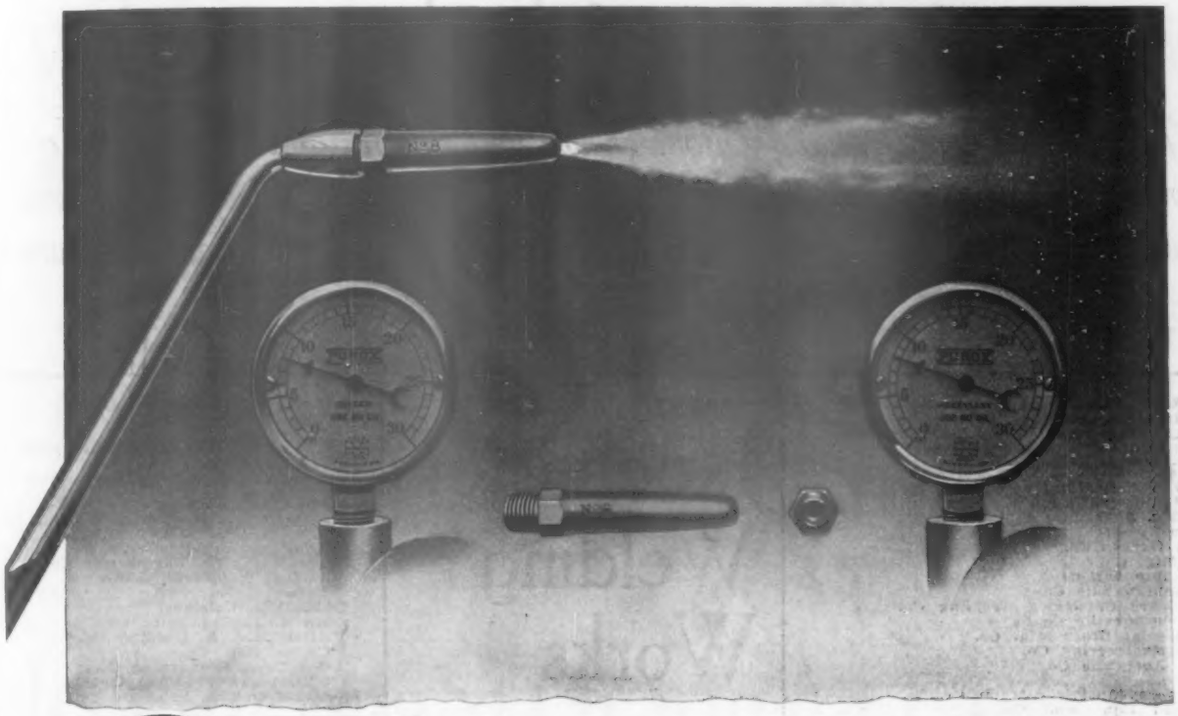
Oxweld

WELDING AND CUTTING APPARATUS

WORLD'S LARGEST MANUFACTURERS OF WELDING AND CUTTING EQUIPMENT



Predetermining Pressures & Profits

BY using a Purox welding torch and setting your pressure gauges to correspond with the tip size number, you can predetermine pressures, costs and profits, because balanced pressures enable you to quickly calculate gas consumption and costs by merely squaring the tip number, and at the same time insure a soft, neutral flame and a solid, efficient, economical weld.

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Kansas City, Mo.

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Seattle, Washington

110 William St.
New York, N. Y.

Buyers' Index

Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

ACETYLENE (Compressed in Cylinders)
Air Reduction Sales Co.
Commercial Acetylene Supply Co.
International Oxygen Co.
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Bierman-Everett Foundry Co.
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Burdett Oxygen Co.
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The Imperial Brass Mfg. Co.
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Modern Engineering Co.
Morey Flux & Chemical Co.
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Purox Co.
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Torchweld Equipment Co.
United States Welding Co.
Weldit Acetylene Co.

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Purox Co.
Sall Mountain Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.

BLOW TORCHES (Acetylene)
See "Torches"

BOOKS (Relating to Welding)
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Electric Arc Cutting & Welding Co.

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Modern Engineering Co.
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We not only do welding, but supervise the design and installation of oxy-acetylene welding plants; report on welding material and methods; make tests on welding apparatus for efficiency and economy.

Nine years' experience.

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Purox Co.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.

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Davis-Bournonville Co.
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Modern Engineering Co.
Oxweld Acetylene Co.
Purox Co.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.

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Wodack Electric Tool Corporation

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Allan Mfg. & Welding Co.
Carbic Mfg. Co.
Gas Tank Recharging Co.
Shawinigan Products Corp.
Union Carbide Sales Co.

CARBIDE (Compressed in Cakes)
Carbic Mfg. Co.

CARBON (Blocks, Paste, Etc.)
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National Carbon Co.
U. S. Welding Co.
Electric Arc Cutting & Welding Co.
Oxweld Acetylene Co.

CARBON REMOVING TORCHES
See "Torches"

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Bierman-Everett Foundry Co.
Carbic Mfg. Co.
Chemical Treatment Company
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Chicago Steel & Wire Co.
Wm. Cramp & Sons
Davis-Bournonville Co.
Electric Arc Welding & Cutting Co.
International Oxygen Co.
Modern Engineering Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Purox Co.
Imperial Brass Mfg. Co.
Page Steel & Wire Co.
John A. Roebling's Sons Co.
Superior Oxy-Acetylene Machine Co
Torchweld Equipment Co.
Transportation Engineering Corp.
United States Welding Co.
Weldit Acetylene Co.

COPPER FLUX
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Bierman-Everett Foundry Co.
Carbic Mfg. Co.
Chemical Treatment Company
Davis-Bournonville Co.
Oxweld Acetylene Co.
Purox Co.
Imperial Brass Mfg. Co.
Weldit Acetylene Co.

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Quasi-Arc Weldrode Co.
Westinghouse Elec. & Mfg. Co.
Todd Shipyards Corporation.

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Gibb Instrument Co.
Quasi-Arc Weldtrode Co.
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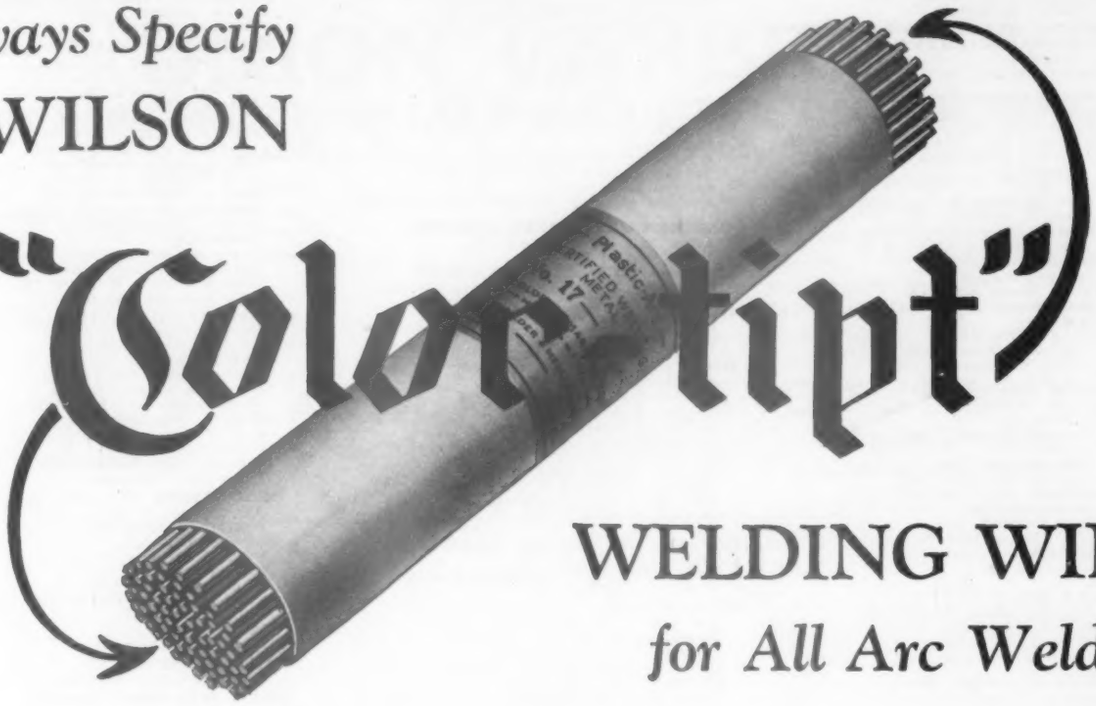

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for All Arc Welding

Select *the* Right Grade *for* Each Job

No. 4

GRADE COLOR "GREEN"

Diameter Size: 5/32"

For flat, vertical and overhead welding. This wire will produce an extremely hard surface on steel and is not machineable. For use where resistance to wear is an important factor—Guides, Rock-Crusher Jaws, Frogs, Rail Heads and Switch Points.

No. 6

GRADE COLOR "WHITE"

Diameter Sizes: 5/32", 1/8"

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No. 9

GRADE COLOR "BLUE"

Diameter Sizes: 3/16", 5/32", 1/8"

For flat, vertical and overhead welding. This wire will produce a weld in steel of over 60,000 lbs. per square inch tensile strength and an elongation of about 15% in one inch in a mechanically sound weld. Machineable at reduced tool speed. For Automobile Frames, Boiler Plate, Cast Steel Parts, Locomotive Frames, Fire Box Seams, Flue Sheet Patches, High Pressure Boiler Work, Oil Pipes, Gas and Steam Pipes, Ship Plates, Tanks, Fish Plates, and Rail Bonds.

No. 20

GRADE COLOR "BROWN"

Diameter Sizes: 5/32", 1/8"

For flat welding only. This wire will produce a weld in brass, bronze, and light gauge copper. For Pump Castings, Water Wheels, Motor End Rings, Tail Shaft Sleeves, Bearings, and Castings.

No. 50

GRADE COLOR "ALUMINUM"

Diameter Size: 5/32"

For welding Sheet Aluminum minimum No. 11 gauge (⅛"). Also for Cast Aluminum minimum thickness 3/16".

No. 12

GRADE COLOR "GRAY"

Diameter Sizes: 5/32", 1/8", 3/32"

For flat welding only. This wire will penetrate cast iron and produce a homogeneous and machineable weld. Readily caulked when cold.

MONEL METAL—WILSON PROCESSED

Diameter Sizes: 5/32", 1/8", 3/32"

For welding Monel Metal and Monel to Steel.

No. 17

GRADE COLOR "RED"

Diameter Sizes: 1/4", 3/16", 5/32", 1/8", 3/32"

For flat, vertical and overhead welding. This wire will produce a sound weld in cast iron where studs are used and in steel a weld of about 50,000 to 55,000 lbs. per square inch tensile strength. On steel it is easily machineable. For Flue Work, Steel Castings, Blow Holes in Gray Iron Castings.

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Wilson Bldg. Hoboken, N. J.

Canadian Distributors: G. D. Peters & Co., Ltd., Montreal

WILSON

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Chicago Steel & Wire Co.
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Modern Engineering Co.
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Oxweld Acetylene Co.
Purox Co.
Page Steel & Wire Co.
Superior Oxy-Acetylene Machine Co.
Transportation Engineering Corp.

FILLER RODS (Tobin Bronze)
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American Brass Co.
Bierman-Everett Foundry Co.
Burdett Oxygen Co.
Central Steel & Wire Co.
Bierman-Everett Foundry Co.
Carbic Mfg. Co.
Davis-Bournonville Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Purox Co.
Page Steel & Wire Co.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.
Weldit Acetylene Co.

FILLER RODS (Vanadium Steel)
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Burdett Oxygen Co.
Bierman-Everett Fdy. Co.
Carbic Mfg. Co.
Central Steel & Wire Co.
Universal Oxygen Co.
Wm. Cramp & Sons
Davis-Bournonville Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
Modern Engineering Co.
Purox Co.
Oxweld Acetylene Co.
Reid-Avery Co.
Torchweld Equipment Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.

FIREPROOF PLASTIC
National Carbon Co.
United States Welding Co.

FLUE WELDERS (Electric)
General Electric Co.

FLUXES
Air Reduction Sales Co.
Bierman-Everett Foundry Co.
Carbic Mfg. Co.
Chemical Treatment Co.
Davis-Bournonville Co.
Imperial Brass Mfg. Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Purox Co.
Weldit Acetylene Co.

FURNACES (Annealing)
Buffalo Dental Mfg. Co.
General Electric Co.

GAS BURNERS (Preheating)
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Purox Co.
Superior Oxy-Acetylene Machine Co.

GAUGES
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Oxweld Acetylene Co.
U. S. Gauge Co.

GENERATORS (Acetylene)
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American Brass Co.
Bastian-Blessing Co.
Carbic Mfg. Co.
Davis-Bournonville Co.
Imperial Brass Mfg. Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Purox Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Weldit Acetylene Co.

GENERATORS (Oxygen or Hydrogen)
Burdett Oxygen Co.
Gas Products Assn.
International Oxygen Co.
Oxweld Acetylene Co.

GLOVES (Welders' Asbestos)
Air Reduction Sales Co.
Burdett Oxygen Co.
Carbic Mfg. Co.
Davis-Bournonville Co.
Electric Arc Cutting & Welding Co.
Ideal Face Shield Co.
International Oxygen Co.
Imperial Brass Mfg. Co.
Purox Co.
Torchweld Equipment Co.
Weldit Acetylene Co.

GOGGLES
Air Reduction Sales Co.
Bastian-Blessing Co.
Carbic Mfg. Co.
Chicago Eye Shield Co.
Ideal Face Shield Co.
Davis-Bournonville Co.
Imperial Brass Mfg. Co.
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Purox Co.
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Transportation Engineering Corp.
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International Oxygen Co.
Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Oxweld Acetylene Co.
Purox Co.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.
Weldit Acetylene Co.

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Carbic Mfg. Co.
Davis-Bournonville Co.
Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Oxweld Acetylene Co.
Purox Co.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.

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International Oxygen Co.

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International Oxygen Co.

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Davis-Bournonville Co.
Harris Calorific Co.
Imperial Brass Mfg. Co.
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Purox Co.
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Torchweld Equipment Co.

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Superior Oxy-Acetylene Machine Co.

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Davis-Bournonville Co.

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Harris Calorific Co.
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Imperial Brass Mfg. Co.
Modern Engineering Co.
National Gauge and Equipment Co.
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Purox Co.
Superior Oxy-Acetylene Machine Co.
U. S. Gauge Co.
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Davis-Bournonville Co.
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Modern Engineering Co.
National Gauge and Equipment Co.
Oxweld Acetylene Co.
Purox Co.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.
Weldit Acetylene Co.

REGULATING VALVES (Hydrogen)
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International Oxygen Co.
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Modern Engineering Co.
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Purox Co.
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National Gauge and Equipment Co.
Oxweld Acetylene Co.
Purox Co.
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SAND BLAST
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SPOT WELDERS (Electric)
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Superior Oxy-Acetylene Machine Co.
United States Welding Co.
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Burdett Oxygen Co.
Davis-Bournonville Co.
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International Oxygen Co.
Modern Engineering Co.
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Torchweld Equipment Co.

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K-G Welding & Cutting Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Purox Co.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.
Weldit Acetylene Co.

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International Oxygen Co.
The Imperial Brass Mfg. Co.
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Modern Engineering Co.
Oxweld Acetylene Co.
Purox Co.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.

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3½	in. x 2	in.	(Lump)
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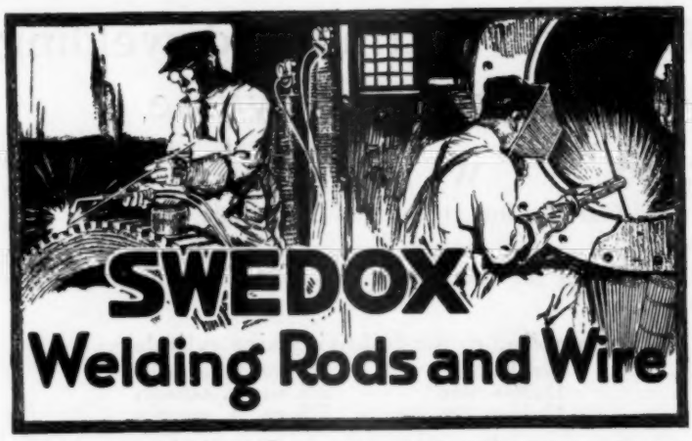

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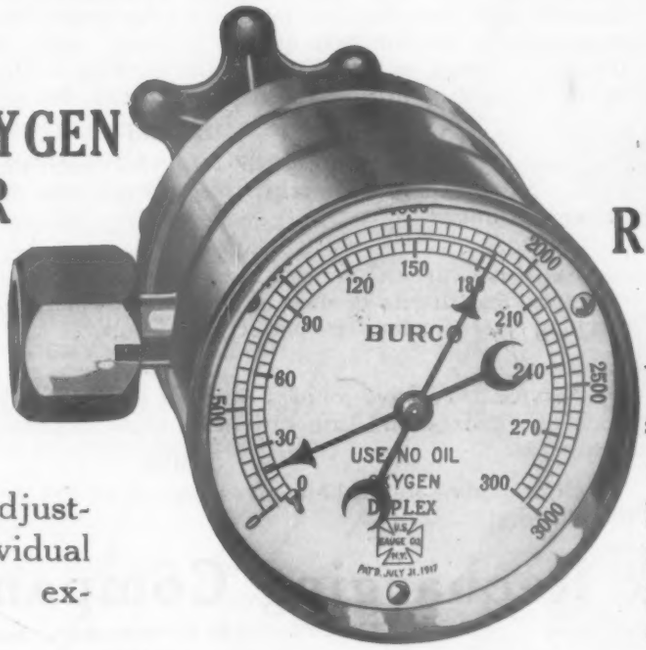

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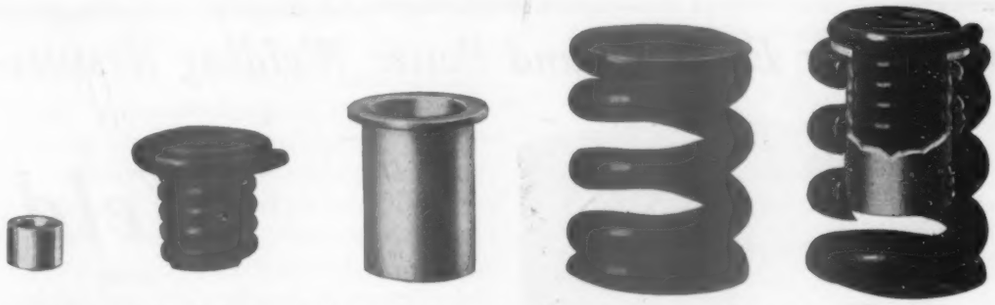

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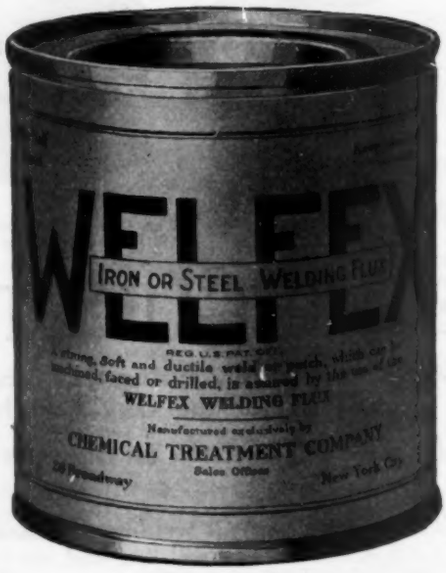

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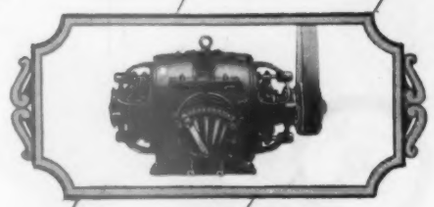

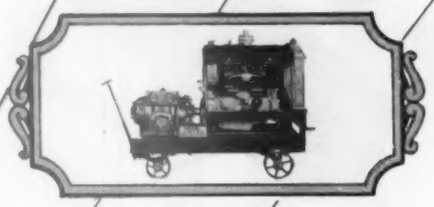

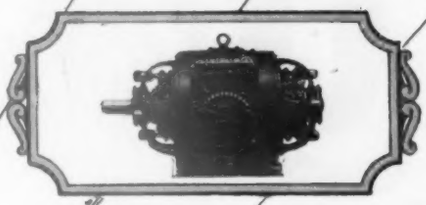

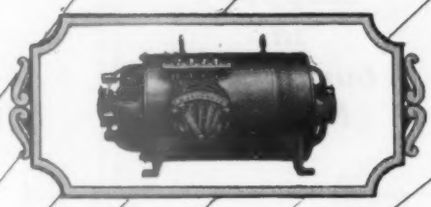

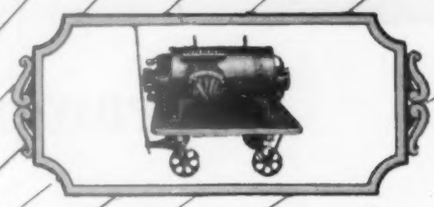

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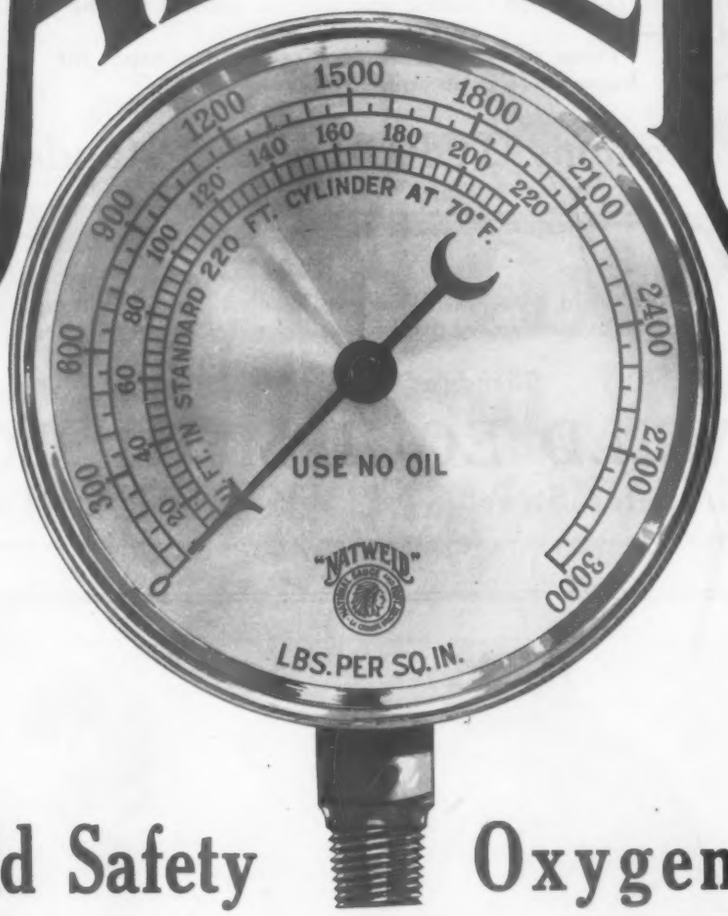

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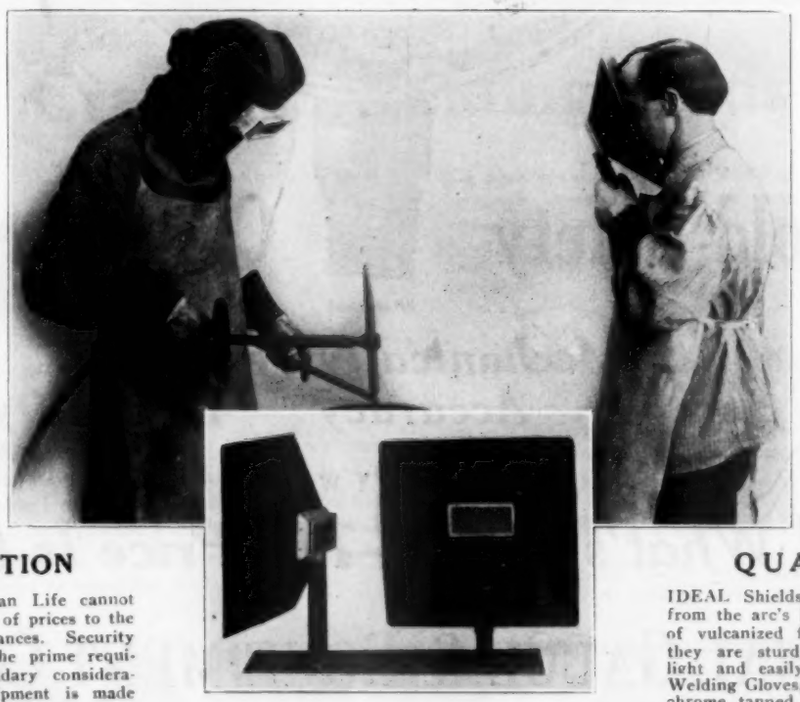

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Protection of Human Life cannot permit the weighing of prices to the extent of taking chances. Security and certainty are the prime requisites—cost, a secondary consideration. IDEAL equipment is made accordingly—assuring all users of flawless protection and working comfort, as well as the greatest possible dollar-for-dollar value.

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IDEAL Shields protect the welder from the arc's harmful rays. Made of vulcanized fibre and aluminum, they are sturdy and durable, yet light and easily adjusted. IDEAL Welding Gloves, of capeskin leather, chrome tanned, repulse grease and resist intense heat. The IDEAL Apron, of thick chrome leather, also resists this heat without tearing or cracking.

Manufactured and Sold by

THE IDEAL FACE SHIELD COMPANY

468 N. Garfield Ave., Columbus, Ohio.

(Taken from 1919 Advertisement)

Get Pure Oxygen for Cutting and Welding

Inferior oxygen is costly and wasteful. Its use means loss of time, labor and efficiency. A slight additional percentage of impurity in oxygen brings a big loss in efficiency.

←Then

We said it away back in 1919, "Get Pure Oxygen for Cutting and Welding."

And the members of this Association still do and always will advocate the use of high purity oxygen—

for, as we said then we say **NOW**

Get Pure Oxygen for Cutting and Welding

GAS PRODUCTS ASSOCIATION

First to Advocate High Purity Oxygen

ALABAMA
*Birmingham—Burdett Oxygen Co.
Birmingham—Standard Gas Products Co. of Alabama.
*Mobile—Louisiana Oxygen Co.

CALIFORNIA
*Fresno—California Compressed Gas Co.
Los Angeles — California Compressed Gas Co.
Oakland—California Compressed Gas Co.
*Redding—California Compressed Gas Co.
*Sacramento — California Compressed Gas Co.
*San Francisco — California Compressed Gas Co.
*San Jose—California Compressed Gas Co.
*Stockton—California Compressed Gas Co.

COLORADO
Denver—Colorado Compressed Gas Co.

ILLINOIS
Chicago—Acme Oxygen Co.
Burdett Oxygen & Hydrogen Co.
Swift & Company
Peoria—Electrox Co.

INDIANA
*Evansville—Kentucky Oxygen-Hydrogen Co.
Indianapolis—Indiana Oxygen Co.
Logansport—Logansport Oxygen Co.
*South Bend—Burdett Oxygen & Hydrogen Co.

IOWA
Bettendorf—Bettendorf Oxygen Hydrogen Co.

KENTUCKY
Louisville—Kentucky Oxygen-Hydrogen Co.

LOUISIANA
New Orleans—Louisiana Oxygen Co.
Shreveport—The Bain-Beaird Co.

MANITOBA
Winnipeg—Auto Lite Gas Co., Ltd.

MARYLAND
*Baltimore—Southern Oxygen Co.

MASSACHUSETTS
Everett—New England Compressed Gas Co.

MICHIGAN
Detroit—Burdett Oxygen Co. of Detroit.
Wall Bros. Co.
*Grand Rapids—Grand Rapids Welding & Supply Co.
Muskegon—Michigan Ox-Hydric Co.

MINNESOTA
Minneapolis—Commercial Gas Co.

MISSOURI
Kansas City—Kansas City Oxygen Gas Co.
Ox-Hydrogen Mfg. Co.

MONTANA
Butte—Mountaineer Welders' Supply Co.

NEBRASKA
Omaha—The Balbach Co.

NEVADA
*Reno — California Compressed Gas Co.

NEW JERSEY
Newark—International Oxygen Co.
*Trenton—Paschall Oxygen Company

NEW YORK
New York—American Oxygen Service Co.

OHIO
Canton—Buckeye Oxygen Co.
Cincinnati—Ohio Electrolytic Oxygen Co.
Cleveland—Burdett Oxygen Co. of Cleveland
*Cleveland—Clarke Chemical Co.
Columbus—Gas Products Co.
Dayton—Dayton Oxygen & Hydrogen Products Co.
Niles—Ohio Oxygen Co.
Portsmouth—Midwest Oxygen Co.
Toledo—International Oxygen Co.
Wickliffe—Clarke Chemical Co.

OKLAHOMA
Oklahoma City — Burdett Oxygen Co. of Oklahoma City.
Tulsa—Tulsa Oxygen Co.

OREGON
Portland—Portland Oxygen & Hydrogen Co.

PENNSYLVANIA
*Allentown—Paschall Oxygen Company.
Norristown—Burdett Oxygen Co.
*Philadelphia—Burdett Oxygen Co.
Philadelphia—Paschall Oxygen Co.
Pittsburgh—Burdett Oxygen & Hydrogen Co.
Verona—International Oxygen Co.
*York — Paschall Oxygen Company

RHODE ISLAND
*Providence — New England Compressed Gas Co.

TENNESSEE
Chattanooga—Burdett Oxygen Co.
*Johnson City — Kentucky Oxygen-Hydrogen Co.
*Knoxville—Burdett Oxygen Co.
*Knoxville—Kentucky Oxygen-Hydrogen Co.
Memphis—Memphis Oxygen Co.
*Nashville—Burdett Oxygen Co.
*Nashville—Kentucky Oxygen-Hydrogen Co.

TEXAS
Beaumont — Magnolia Gas Products Co.
*Dallas—Burdett Oxygen Co of Texas
Ft. Worth—Burdett Oxygen Co. of Texas
*Galveston—Gregory Auto Supply Co.
Houston—Magnolia Gas Products Co.
*Ranger—Burdett Oxygen Co. of Texas
*Waco—Burdett Oxygen Co. of Texas
*Wichita Falls—Burdett Oxygen Co. of Texas

UTAH
Salt Lake City—Utah Compressed Gas Co.
*Ogden—Utah Compressed Gas Co.

VIRGINIA
South Washington—Southern Oxygen Co.

WASHINGTON
*Bellingham — Washington Compressed Gas Co.
*Everett—Washington Compressed Gas Co.
Seattle — Washington Compressed Gas Co.
*Tacoma—Washington Compressed Gas Co.

WEST VIRGINIA
*Charleston—Kentucky Oxygen-Hydrogen Co.

WISCONSIN
*Appleton—Universal Oxygen Co.
*Fond du Lac — Universal Oxygen Co.
*Green Bay—Universal Oxygen Co.
Kenosha—Wisconsin Oxygen & Hydrogen Co.
*Madison—Universal Oxygen Co.
*Manitowoc—Universal Oxygen Co.
Milwaukee—Universal Oxygen Co.
Sheboygan—Universal Oxygen Co.

*Signifies warehouses

"This phase of our service will be recognized"—

wrote a vice-president of the Linde Company six years ago

IN RECOMMENDING that the Linde Company enlarge its service to include the giving of help to Linde customers in their use of processes requiring Linde oxygen, this vice-president wrote six years ago:

> "This phase of our service can, I am confident, be developed to an extent that, in the course of time it will be recognized by a large percentage of the users of our products as an important factor in the oxy-acetylene field, and will be called upon freely for advice in small as well as large matters."

Time has proved the soundness of this prediction. Thousands of Linde users depend upon Linde Process Service to increase their profits from the use of Linde oxygen. Moreover, the fact that practically all oxygen manufacturers now offer service of this kind indicates that the whole oxygen industry recognizes its value.

Linde Process Service is planned for every Linde user. It reaches out into the shop where but one blowpipe is owned to make its use better and more profitable. It goes to the largest industrial organizations to be of help to every one from the welder's helper to the president.

Each individual case challenges the ability of Linde Process Service to quickly and efficiently adapt itself to the size and difficulty of the problem. Successful service in each specific case makes Linde Process Service better and more helpful to all Linde customers.

Linde Process Service is free to every Linde user for the asking

THE LINDE AIR PRODUCTS COMPANY

General Offices: Carbide & Carbon Building
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37 PLANTS — 80 WAREHOUSES

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MILWAUKEE
NEW ORLEANS
NEW YORK
PHILADELPHIA
PITTSBURGH
ST. LOUIS
SALT LAKE CITY
SAN FRANCISCO
SEATTLE
TULSA

LINDE OXYGEN

YOU CAN DEPEND ON THE LINDE COMPANY

Locomotive and Car Repair

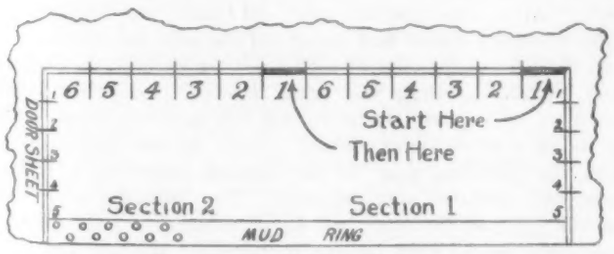
How One Railroad Company Uses Welding for Reconditioning Fireboxes, Engine Frames and Other Car Parts

By H. D. Adell*

ABOUT ninety-seven per cent of the welding done by The Missouri & Northern Arkansas Railway consists of locomotive and car repairing. Nearly all the work falling into this classification is electrically welded, only the cutting being done by the gas process.

One of the most important jobs we meet is the repair of fireboxes, all of which are electrically welded. In applying the half side sheets we first cut all stay bolts in the damaged area. We cut these on the outside with a cutting torch, averaging about 80 per hour. The sheet is then cut off slightly above the last row of bolts which have been cut, and removed. In doing this we leave enough stock so that new sheet may be cut to exact width, beveled, and placed in position to be used as a straight edge for making the final cut which is made on a bevel. Dropping the new sheet a few inches, this upper edge is then chipped in order to remove all burned iron, after which the sheet is bolted in place and—unless it has already been done—an opening of 5/32 inches is made in the bottom of the vee. (This method is used in fitting half sheets and all other patches.) The sheet is then tack welded about every twelve inches for the entire length of the seam, the tack weld being about one inch long and one layer. The line of weld is then divided into equal parts and the welding proceeds as indicated in the illustration.

The first layer is started, as indicated, at No. 1, section 1. The first layer is then applied to No. 1, section 2, allowing the weld in section 1 to cool meanwhile. Then return to No. 1, section 1, for the second layer, finishing slightly more than flush, and repeating this alternating procedure throughout the entire horizontal seam. The ends are then welded in the same fashion.



Procedure in Welding Fireboxes

In this way—using two layers of metal and alternating from one end of the sheet to the middle—we have been able to reduce expansion and contraction to such an extent that breaking in these light one-inch tack welds is practically unknown. In applying one-half flue and door sheets, corner patches, door patches, and rings, this same method is followed as closely as possible.

This same step back process we use in welding cracks in fire boxes, excepting when the crack is veed out. We cut a counter sunk hole at each end of the crack—the holes being about ¾ inches in diameter—and by welding up the holes last we very handily avoid the trouble of distortion.

In the matter of welding tubes in flue sheet it apparently makes no difference whether there is water—hot or cold—present in the boiler or not. We have had satisfactory results under all conditions. The sheet is sanded thoroughly and all burs are trimmed off. Using a one-eighth rod, the weld is started at the top of the sheet and the bottom of the tube, and proceeds half way around. Then it is started from the bottom and continues until finished. The arc stream must be kept playing on the sheet rather than on the flue, and as much heat must be secured as can be handled by the operator without making a heavy weld.

Staybolt holes of more than one inch diameter may also be reduced by means of the arc. We have done a considerable amount of this work. With practice an operator can reduce them without filling them full, eliminating the necessity of drilling, although reaming is necessary. All cracks, patches, etc., in

Photo 1—Two of the Welds Viewed from Without

tanks and smoke boxes are handled in a manner similar to that of our fire box repairs. We permit no lap welds of any description where same may be avoided, and wherever possible all seams are welded on both sides. Safe ends of all superheater tubes are gas welded, using a butt weld.

Locomotive Frames

The repair of locomotive frames constitutes another large part of the work which we consign to the electric process. We are glad to announce that during the period of one and one-half years we have been using this method, our record of successful welds has been very close to one hundred per cent. The frame which is to be repaired is veed, wherever possible, from both sides, the vee being made as narrow as possible and yet allowing easy access of the electrode to the bottom. The frame is then expanded one-eighth. After closing the bottom of the vee with about half an inch of added metal, it is given a light application of the air hammer, and a bobbing tool is used to upset the metal and remove the scale preparatory to resuming the welding. This operation follows each layer of added metal. The layers, themselves, are alternated, one perpendicular and then one horizontal, and—when only one machine is used—changing sides after each layer. The weld is finished with a reinforcement of about ¼ inch on each side, top and bottom. For the bottom we use ¼ inch boiler steel, tacked on before starting to weld, and weld to it as each layer is added. Pedestals are welded in practically the same manner, excepting that the vee is made horizontally and double wherever possible. In the event that a single or one sided vee must be resorted to we allow about one-eighth of an inch for contraction, both horizontally and perpendicularly.

*Welding Foreman, M. & N. A. Ry. Co.

The accompanying photos show the left side of an engine in which a break occurred at the weld marked No. 1 through a bolt hole. There being an old thermit weld between Nos. 2 and 3, this weld was cut out and the front portion of the frame taken down, welds 1 and 2 being made on the floor after the smith had made a block to take the place of the portion cut out. The frame was then pulled back into position, extended ⅛ inch, and the weld executed.

The actual welding time for the three welds was about twelve hours, using one machine on Nos. 1 and 2 and two machines on No. 3. All were double "V" welds, No. 1 being reinforced by only about ⅜ inch on the inside and bottom, the other two being reinforced about ¼ inch all around. In a way this was an experimental job yet time out of service had a great deal to do with the making of a triple weld instead of a new section of the frame which would have delayed getting the engine in service a considerable length of time.

Photo 2—Other Side of Frame Showing Three Welds

I might add that each layer of material was thoroughly hammered with a fuller and that weld No. 3 only contracted about $\frac{3}{64}$ of an inch, leaving the frame approximately $\frac{1}{64}$ inch longer perimental job, yet time out of service had a great deal to do with than it was originally. The engine has been in service several months now making about 250 miles a day and has shown no sign of weakness.

Worn Parts

We have utilized to a very considerable extent the welding process in reclamation work—building up and reinforcing, wherever possible and profitable, all worn places and parts of frames. The car department is our greatest source of reclamation, including, as it does, the repairing of bolsters, knuckles, couplers, buffer blocks, side frames, etc. But in addition to these there are buffer castings, pins, worn holes, and mis-machined parts which we have found may be built up successfully and profitably by good welders.

Not the least in these items of reclamation is that of worn steel tire flanges. We rebuild these with the electric process using about eighty point high carbon electrode with reversed polarity, being careful to hold the heat to a point where good fusion will be secured without bringing the flange to a red heat clear through. Adding the metal in this work is done by a circular motion of the electrode, and the fill is made in one layer. We have built up hundreds of flanges after this fashion, some of them for the third time, and have not had a failure that could be attributed to the welding.

We have also had some success in the welding of cast iron, copper, and bronze with the electric process, but as our work along this line is chiefly of an experimental sort, we use the gas process for welding these metals in cases requiring dependability. While we have not yet gone extensively into the work of track welding, we are satisfied that here, too, a great saving may be realized by the railroads through the welding process.

OXY-ACETYLENE AND ELECTRIC WELDING WORK HAND IN HAND ON AN EMERGENCY JOB

Dear Editor:

We had quite an interesting job in our shop recently and since it turned out so very successfully I have decided to pass along the account of it to the men on the "Firing Line."

The job which I have just mentioned was on a large "finger gear." This large gear was taken from a set of rolls which were used for crushing the lock taken from the precious metal mines. It measured approximately seven feet in diameter. The face of the teeth was nine inches wide and the depth was four inches. This large gear was bored out at the hub to fit a seven-inch steel shaft with hydraulic pressure. In addition the hub was also keyed on.

The cost of this gear ran high into three figures and for this reason we hesitated to undertake the job. The trouble had been caused by the continuous vibration and the variation of the load. These conditions had caused the gear to move forward on the shaft about one inch. The problem was to move the gear back in place.

Our first thought was to slacken the key and then by using iron straps one inch by six inches, and slotted in the center, and attached to a five-hundred ton hydraulic press we would be able to draw the gear back. With this arrangement, we commenced to draw the gear back, the pull being at the back of the hub. For the moment everything appeared to be progressing very well, when suddenly the gear lurched ahead three inches and seized so tightly on the shaft that it could not be moved in either direction.

At this point the welder was called upon to see what he could suggest. After sizing up the trouble he asked the master mechanic if he would allow him to use his own judgment throughout the entire job. At the same time he assured him that the work would be satisfactory and the master mechanic told him to go right ahead. The welder brought out his equipment and with a heavy cutting torch cut a slot one and one-half inches in width clear through the hub, of the steel finger gear, to the shaft.

The cutting together with the heating of the hub caused it to expand to such an extent that it was easy to remove it from the shaft. After removing the gear, the shaft was found to be badly marked where it had seized and the next operation was to send the gear to the electric welder and the shaft to the machine shop. While the shaft was being repaired, the electric welder was busy adding new metal to the hub and afterwards filling up the slot in the same manner. After he had completed his work, he sent the gear to the machine shop where it was bored out again to suit the shaft. The hydraulic press men put the gear on the shaft and keyed it back in place when it was again put to work, where it has stood the test and is in active service now.

When one considers that this work was done in less than twenty-four hours, it speaks volumes for the welding industry, which we know has only touched the fringe of its ultimate possibilities.

Yours for welding,

George Kingsley Reed,

Canada.

Smith's Inventions, Inc., Minneapolis, Minn., have recently issued a new thirty-page catalogue, listing and describing that company's complete line of welding and cutting equipment.

The International Oxygen Company, at the annual meeting of the stockholders, held January 20, 1925, unanimously re-elected the old officers of that company with the addition of Mr. John Heller, as secretary. The newly elected board declared a dividend of 6 per cent on all outstanding stock of the company, payable semi-annually.

G. P. A. Mid-Winter Meeting

"Prosperity Convention" of Gas Products Association, Held in Chicago, Has Varied and Interesting Program

THE Gas Products Association held its "Prosperity Convention"—the eleventh mid-winter meeting—in Chicago, January 22, 23, 24, with more than 100 members and visitors attending. Business sessions and the banquet on the final evening were held in the Hotel Sherman. If the general tone and spirit of the meeting, and the attitude of the attending members, may be taken as a true gauge of conditions in the industry, the meeting was properly named, for prosperity was reported on all sides, as well as bright prospects for the future.

In the absence of M. L. Goodrich, president of the Association, who was compelled to be absent on account of sickness, the convention was presided over by the vice-president, H. B. Pearson. The Thursday morning session (Jan. 22) opened with Mr. Pearsons' address, in which he briefly surveyed the growth of the gas industries, their associated fields, and the association, itself.

A. J. Russell, of the Bettendorf Oxygen Hydrogen Company, conducted "Who's Who," a novel way of introducing each member individually to the rest of the assemblage. The remainder of this session was devoted to reports of the secretary and treasurer, read by Mr. Charles T. Allen, secretary of the Association, and the report of the finance committee, delivered by Mr. Pearson.

A series of separate meetings were held by the apparatus group of the Association. Under the leadership of W. A. Slack, chairman of the committee, these sessions produced some lively discussion on pertinent apparatus topics.

On Friday the members were the luncheon guests of the Bastian Blessing Company at Grayling's, after which several of them visited the Bastian-Blessing Plant. The afternoon session was devoted to the reports of various committees, among them being Membership, by O. E. Engler; Educational, by C. E. Phillips; Transportation, by James H. Brown; Standardization, by A. J. Fausek; Publicity, by J. R. Brant.

In his report for the Educational Committee, Mr. Phillips cited the urgent necessity of instructing welders. He referred to certain locomotive welded boiler accidents which had occurred during the past year, some of them entailing a loss of life. "These," said Mr. Phillips, "were undoubtedly due to the incompetence of the men who did the work, and certainly not to the process of welding. Nevertheless, they have resulted in a very unfavorable report on welding by the Bureau of Locomotive Engineers. Moreover the attitude of the Interstate Commerce Commission is not at all friendly. They have intimated their intention of taking action against the welding of locomotive boilers unless something is done to change their opinion. It is for us to do something , and the thing to do is obvious—spread information and further the work of educating and instructing the men who do the welding."

Mr. Fausek reported for the Standardization Committee, that the Association had adopted, in concurrence with the International Acetylene Association, standard designs for hose connections. (A discussion and description of these designs was published in the December, 1924, issue of *The Welding Engineer*.) The high point of interest in the afternoon's program proved to be Archibald Harris' talk on income tax. The "taxpert" answered and clarified numerous tax questions and problems put to him by the members.

The program for Saturday morning included "Handling Apparatus in Connection with an Oxygen Business," by E. H. Smith, of the Commercial Gas Company; "Why We Feel That the Manufacturers Should Be Against the 20th Amendment," by John M. Glenn, Secretary, Illinois Manufacturers' Association; "Cost of Operating Trucks," by C. F. Buckmaster, of the White Company; and "Sales and Sales Problems," by J. R. Foran, Kansas City Oxygen Gas Company. In the discussion following this last mentioned paper, the opinion was expressed by some members that the salesman, in addition to what is ordinarily considered his work, should be alert to introduce the use of oxy-acetylene welding and cutting into fields where it has heretofore been unused. Several instances were cited where this had been done—where aggressive and original salesmen had demonstrated to manufacturers and managers that the use of welding or cutting equipment could speed up and improve production, and so opened new fields of sales.

In the afternoon session John M. Young, of the Brinner Studios, addressed the convention on the use of motion pictures to promote general interest in the oxy-acetylene process. Following his talk the opinion was expressed by several members that the industry should take positive steps to adopt this form of publicity which has proven successful in numerous other industries. E. A. Bienenstok, of the Milwaukee Tank Works, addressed the meeting on automatic tank welding, advocating, in-

(*Continued on page* 22)

Eleventh Winter Meeting of the Gas Products Association, Held in Chicago, January 22, 23, 24, 1925

C. G. M. A. Reviews the Past

Compressed Gas Manufacturers' Convention Was Great Success—Past Results Show Progress and Present Plans Will Accomplish Still More

SEVENTY-FIVE member companies were represented at the twelfth annual meeting of the Compressed Gas Manufacturers' Association held at the Hotel Astor, New York City, on January 26th.

The growing dominance of the compressed gas industry in national industrial life and the smooth functioning of the association in safely guarding it through its present rapid expansion were points of major interest. Growth and increasing activity of the association was shown in its action in increasing quorums for future meetings. Effective cooperation of the association with public and regulatory bodies during the past year achieved gratifying results.

Compressed Gas Manufacturers' Association Twelfth Annual Convention, Held in New York City, January 26, 1925

The following officers were elected for 1925: Otto S. King, Ohio Chemical & Manufacturing Co., president; F. A. Johnston, S. S. White, Dental Mfg. Co., vice-president; J. H. Leuning, secretary-treasurer.

A. Cressy Morrison, president, opened the meeting by pointing out the stabilizing influence exerted by the association, showing that it possessed smooth working, well-oiled mechanism, enjoyed both the confidence and cooperation of public officials and regulatory bodies, and thus forestalled trouble or eliminated it in its early stages with the result that the industry had suffered no momentous or unfavorable developments. The Association was pictured as always ready to serve and cope with any emergency, unfailingly.

Real accomplishments of the past year, as presented in reports of officers and committees included continuous working with regulatory bodies in preparing of specifications for gas cylinder safety devices, the determining of the value of various alloys for gas cylinder steels, investigating test results on gas cylinders in actual service, and making changes in tank cars for transportation of liquefied gases.

The association worked effectively with the Bureau of Explosives, National Safety Council, National Board of Fire Underwriters and the American Engineering Standards Committee.

Rules for the safe handling, use and storage of compressed gases were promulgated and were distributed among the industry.

Development of new uses of carbon dioxide was carried out through a fellowship at the Mellon Institute.

Material for oxygen regulator seats was the subject of original research work and an exhaustive report of findings was published and widely distributed.

Technical information and data was collected and disseminated and plans for increasing this service were made.

The maintaining of equitable freight rates called for continuous work. Good results were secured.

The election of officers followed presentation of the reports and a resolution congratulating the secretary for his able work concluded the business of the day.

The banquet at the Hotel Astor that evening proved very enjoyable. There were present 228 representatives of member companies and guests. Mr. A. Cressy Morrison, toastmaster, in his introductory remarks called attention to recently published Bureau of Census figures on the vastly increased production of compressed gases, striking evidence of the rapid growth of the industry.

Speakers included Col. B. W. Dunn, of the Bureau of Explosives; Otto S. King, newly elected president; Major J. C. Minor, who presented a token of appreciation to Mr. H. Thompson on behalf of the executive board of the association; J. R. Colby, of Canada, chairman of the association's Canadian section; J. A. Steinmetz, A. R. Brunker, past president, and J. H. Hayes, former secretary. Entertainment followed. The affair was voted a huge success.

G. P. A. MID-WINTER MEETING

(*Continued from page 21*)

cidentally, that the oxy-acetylene industry bend its efforts toward still further application to large scale manufacture. G. H. Henes, of the Board of Industrial Education, Milwaukee, Wis., told the members about the work of the welding class in the Milwaukee Vocational School.

The banquet in the evening formed a fitting climax to a very interesting and enjoyable gathering. A list of entertaining speakers were present, among them being Homer B. Sayre, Commissioner of the National Metal Trades Association, who delivered a splendid address on "Labor and Business." J. F. Bryan, Secretary of the Illinois Lumber Merchants' Association, talked on the "Value or Organization". Entertainment, arranged for by Chairman E. A. Faulhaber, was interspersed in the program so that at no time were dull care and worry allowed to enter into the spirit of the evening.

Fabricating Large Structures*

Welding Versus Riveting in Structural Work—Simpler Drawings Required—Welding as a Substitute Method of Fabrication

By H. Goldmark†, W. Spraragen††, and W. L. Warner†††

PART II

MR. H. L. UNLAND in a paper presented before the Society of Engineers of Eastern Pennsylvania in 1921 describes a test which was made on the roof trusses for a factory building in Brooklyn by the Bureau of Buildings of the City of New York in 1920. See Fig. 3. This building was completely arc welded as an experiment by the Electric Welding Company of America.

The trusses are of the "Fan" type of design and all members are electrically welded together, no bolts or rivets being used. See Figs. 4 and 5.

Fig. 3—Electrically Welded Roof Trusses Being Tested by Department of Buildings, City of New York

Tests on Arc Welded Roof Truss

The object of the test was to demonstrate whether electric welding was a suitable method of uniting structural steel members and also the reliability of the arc welded parts as compared with riveting. As the angle of the truss or roof was greater than 20 deg., the live load prescribed by the Building Code was 30 lb. per square foot of horizontal plane. As the trusses were intended to be set on 30 ft. centers the roof area to be supported was 800 sq. ft. By doubling the live load, the stress in the members of the truss would closely approach the elastic limit of the material.

The load applied was 60 lb. to the square foot or 48,000 lb. per truss. As it was necessary to set up two (2) trusses to balance the load, this load was doubled or 96,000 lb. total was used. The trusses were set upon H section columns laid under the ends of the trusses in a horizontal position on the top of a plank to distribute the load over considerable area.

The roof purlins were 3 in. x 10 in. spruce and were doubled to carry the load. The planking under the load was also of the same material. The two loads were concentrated over an area of about 5 ft. in width at each truss. The load consisted of roofing gravel in bags which average 55 lb. to the bag. These bags were piled in tiers. Readings were taken at different increments of the loading for the deflection in the truss or members, and as a whole, these were checked each time from a bench mark. The instrument used was an engineer's Y-level and target rod divided in feet and tenths.

It is interesting to note that the maximum actual deflection of any part of the truss under full load was $\frac{9}{16}$ in. at the center of the span. The load was allowed to remain on the trusses for 48 hours with no increase of deflection and then it was totally removed and readings taken. These latter readings showed that all points in the truss had returned to their original position leaving no permanent deflection with the exception of the center which showed a deflection of $\frac{1}{16}$ in.

The report goes on to state further "From the above data, it is evident that electric welding is a dependable method of uniting structural members and is stiffer than riveting, if the work is properly performed.

Prior to the test as above, we had a sample of welding on a lap weld of 1¼ in. x ⅜ in. bars, the ends being lapped 1¾ in. and welded across the edges. This weld was put in the machine in direct tension and developed the full strength of the bar. The break occurred in the bar 3 in. above the weld and developed a strength equal to 60,000 lb. per square inch without affecting the weld. These welds when cut across showed no line or markation between the weld metal and the original bar metal.

Another specimen consisted of two (2) angles (2 in. x 3 in. x ⅜ in.) set at right angles and lap welded at the intersection, with the 3-in. legs vertical. This specimen, which was set in the testing machine so that there was a horizontal lever

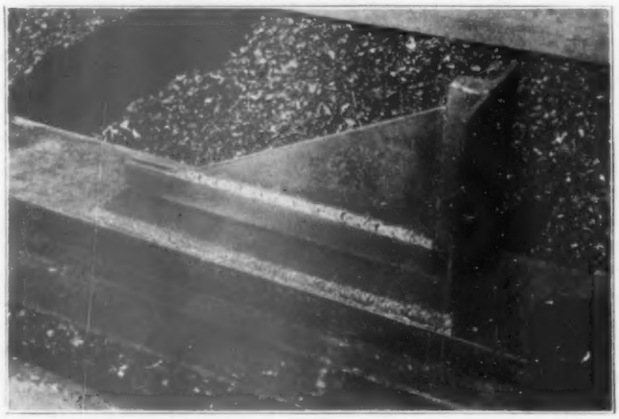


Fig. 4—Supporting Bracket Fore Crane Runway Electrically Welded to Column of Structural Steel Work

arm of 8 in. from the center of pressure to the center of the weld at the intersection, developed a beam load of 11,375 lb. at the weld or a torsional stress of 91,000 lb. at the weld with no apparent distress to the weld, the angles buckling to such an extent that they failed to resist pressure.

Mr. Unland further remarks: "This structure was intended to carry very heavy loads and from the illustrations, showing the welded joints (Figs. 3, 4 and 5), entire success would be expected. Very little information is available as to the cost of completing this structure, but the designer and constructor, Mr. H. B. Payne, is certain that, with the experience gained

*Presented at the Fall Meeting, A. W. S., Cleveland, Oct., 1924.

†Consulting Engineer.

††Secretary, American Bureau of Welding.

†††Industrial Engineering Department, General Electric Co.

on this structure, similar structures could be erected at a much lower cost than if riveted construction were used.

"While it is probable that with proper design and under competent supervision, skilled welders could successfully put up welded structures of any size, we must remember that there is little experience as to the design of the joints most suitable for replacing riveted joints. Slow progress in making this change is greatly to be desired. Experience with smaller structures will furnish a safe guide in trying out the larger ones."

Fig. 5—Electrically Welded Joints

Shearing Strength of Welds

Practically all riveted joints depend for their strength upon the shearing value of rivets or on the bearing of rivets upon the plates connected. If welding is to be substituted for riveting in many places the deposited metal at the weld will be subject to shear and therefore considerable data is needed on this subject. Some tests were made by Mr. E. S. Humphreys at Union College and the results given in a paper printed in May 25, 1922, issue of Iron Age. The type of specimens used is illustrated in Fig. 6 which shows two test specimens after being submitted to a tensile test to fracture. Each specimen consisted of two plates joined together by two splice bars in such a manner that deposited metals or beads run parallel to the length of the plates and therefore parallel to the tensile pull exerted upon these plates with the result that the beads are subjected to shear. The shearing strength of the deposited metal from a commercial bare electrode was found by Mr. Humphreys to be about 36,000 lb. per square inch. From these tests Professor McKibben of Union College has arrived at certain figures which give the maximum safe load in pounds per lineal inch of bead which various sizes of weld beads will safely carry with a factor of safety of four. Full information as to the calculations used by Prof. McKibben in designing a welded truss is given in Appendix "A."

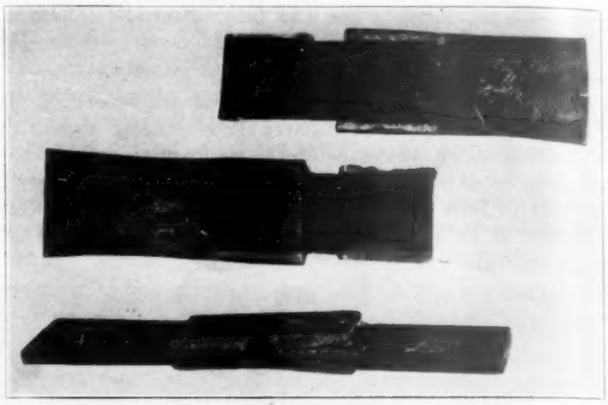


Fig. 6—Shearing Tests. Top and Middle Pieces are Two Parts of Broken Specimen. Bottom Piece Shows Shearing of the Bend

Appendix A

Design for a Riveted Steel Truss for Static Loads*

By F. P. McKibben†

Practically all riveted joints depend for their strength upon the shearing value of the rivets or on the bearing of rivets upon plates connected, and it is comparatively easy to substitute electric welding for rivets in many structures without materially changing the present standard forms for steel members, the deposited metal at the weld will be subjected to shearing rather than to tensile stresses. The best data thus far published on shearing strength of deposited metal are those of E. S. Humphreys, Jr., made at the General Electric Company's Schenectady plant and at Union College, published in Iron Age, May 25, 1922. The accompanying figures and tables give the results of these tests, which mark such a step forward as to merit some attention. Referring to Figs. 20 and 21 it is seen that each specimen consists of two plates joined together by two splice plates in such a manner that the deposited metal, or beads, runs parallel to the length of the plates and therefore parallel to the tensile pull exerted upon these plates, with the result that the beads are subjected to shear. It is just this action that will be brought upon beads deposited in many joints of electrically welded bridge and roof trusses.

The shearing strength of the bead varies from 31,145 lb. per square inch for the ½-in. bead to 42,000 lb. per square inch for the ¼-in. bead, and the table shows quite conclusively that the smaller the bead the greater is the unit shearing strength in pounds per square inch. It should be pointed out here that when these specimens failed in the testing machine the plane of fracture, i. e. plane of shear, was not the base of the triangular fillet but was on a plane extending from the

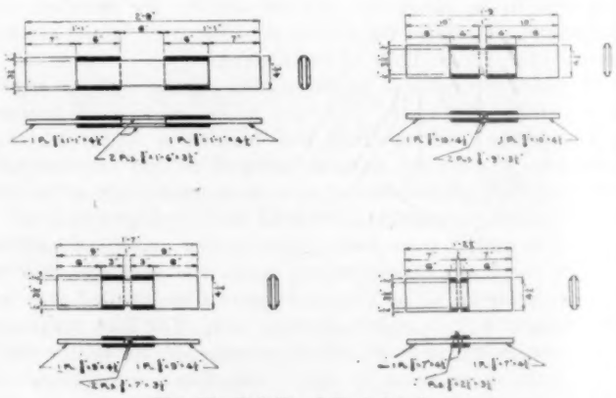


Fig. 20—Details of Test Specimens

Taken from an article appearing in the Feb., 1922, issue of the Journal of the A. W. S.

†*Professor of Civil Engineering, Union College, Schenectady, N. Y.*

apex of the triangle perpendicularly to the hypothenuse opposite the plane of smallest shearing arear. The plates were of ordinary structural steel quality and the electrode was a standard commercial bare wire, high in manganese and low in carbon, sulphur, phosphorus and silicon. The average shearing strength of the beads for all specimens which failed by shear was 36,310 lb. per square inch.

Safe Allowable Shearing Strength for Beads at 9,000 Lb. Per Square Inch

A	B	X	Safe strength per linear inch of bead
in.	in.	in.	lb.
½	½	0.355	3195
⅜	½	0.300	2700
⅜	⅜	0.266	2394
¼	⅜	0.203	1827
¼	¼	0.177	1593

If a factor of four be applied, the safe allowable shearing strength per square inch of longitudinal section of bead on the minimum section is approximately 9,000 lb. per square inch. Using this value, Table above shows the allowable safe working stresses in pounds per linear inch of bead for beads of varying dimensions. For example, for a triangular bead ½ in. deep by ½ in. horizontally the minimum shearing section would be 0.355 sq. in., which multiplied by 9000 per square inch, the safe working shearing strength, gives 3195 lb. per linear inch of bead.

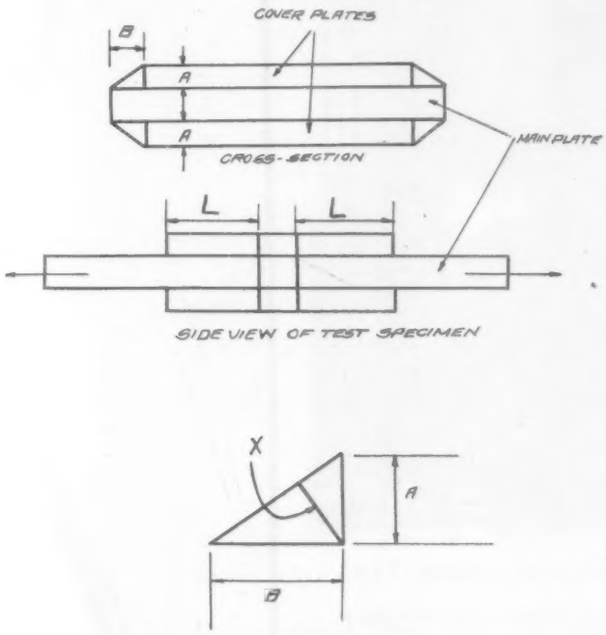


Fig. 21—Details of Test Specimen

In Fig. 22 is shown a preliminary design for an arc welded truss, having a span of 56.4 ft., and carrying a load of 126,000 lb. at the center point C. The following safe unit stresses have been used:

Tension 16,000 lb. per square inch.

Compression $15{,}000 - 50\frac{L}{r}$

L = Length of member; r = Radius of gyration of cross-section.

Shearing in beads — 9000 lb. per square inch.

All welds are of the fillet type, triangular in cross-section and the strength of these fillets are shown in the upper left-hand corner of Fig. 22, the 7/16-in. x 7/16-in. fillet having a safe working strength per linear inch of 0.31 x 9000 = 2790 lb.; and the ½-in. x ½-in. fillet a working strength of 0.335 x 9000 = 3195 lb. To determine the required length of fillet, or bead, to develop in shear a safe strength equal to the stress exerted by the member BC is merely necessary to divide the stress, 89,200 lb. by the safe shearing strength of a ½-in. x ½-in. bead per linear inch, i. e., by 3195 lb., thus giving 27.8 in., or 14 in. for each of the two angles of member BC. The compactness of the joints in the electrically welded truss is very noticeable, and there is a great saving of material in such joints over the ordinary type of riveted joint. Just what the saving in cost may be is at present a matter of conjecture because we have not had sufficient experience to secure accurate cost data on electric welding of such structures.

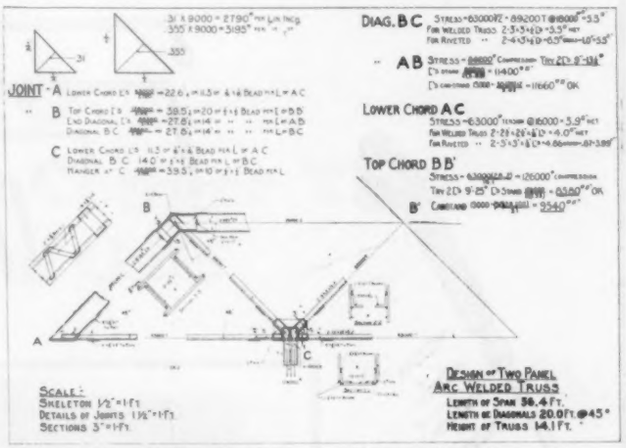


Fig. 22—Design of Two Panel Arc Welded Truss

Another very important advantage which the welded truss has over the riveted truss consists in saving material in tension members due to the reduction of cross-section in riveted trusses caused by the rivet holes. For example, in the welded truss shown in Fig. 22 the tension member AC is made up of two 2½-in. x 2½ x 7/16-in. angles with a cross-section of 4 sq. in., and this is also the net section, as there is no reduction of area. In the riveted truss (Fig. 23), this lower chord member AC is made up of two 3-in. x 3-in. x 7/16-in. angles with a cross area of 4.86 sq. in., but as the rivet holes take out 0.87 sq. in. the net is only 3.99 sq. in. The diagonal BC in the riveted truss also suffers loss due to the presence of rivets. The saving of weight in the four tension members of the welded truss over the corresponding members of the riveted truss due to reduction of area caused by rivets alone is 304 lb. The weight of steel in the angles of the four tension members of the welded truss is 1520 lb., and weight in the four corresponding members of the riveted truss is 1824 lb. The saving by the use of the welded truss so far as main tension members are concerned is 16 2/3 per cent of the weight of metal in the four riveted tension members. No rivets have been used in the welded truss shown in Fig. 22, but perhaps a more careful study would show that greater economy could be secured by using rivets in some places and welding in others. For example, it may be desirable to use rivets in the lattice bars of the compression members which in Fig. 22 are shown welded.

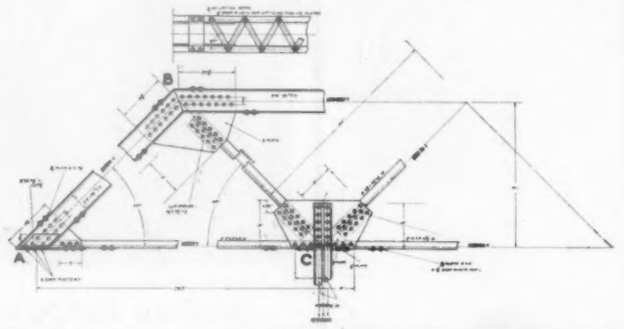


Fig. 23—Design of Two Panel Riveted Truss with Same Loading and Span as Fig. 22

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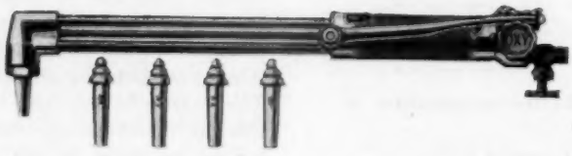

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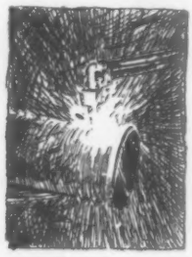

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Welding Pipe Bends in Any Form

Repairing of City Gas Lines Proves to Be Large Item in the Uses of Acetylene Welding

USE of welded steel pipe and pipe bends by city gas companies in place of cast iron pipe and fittings has introduced a new phase in gas main installation and upkeep. It is not necessary here to expand on the advantages of welded pipe and fittings, especially the latter in repair work, as they are obvious to any one having experience with the making of special pipe patterns and waiting on the foundry for the castings.

Fig. 1—Welded Double Offset with 16 Inch Drop

The gas plant welding shop, having a stock of standard pipe and a corps of experienced welders, is in position to quickly fabricate and weld any form required for the extension or repair of the mains, no matter what the shape or number of outlets may be.

The Iroquois Gas Corporation of Buffalo, N. Y. has demonstrated that quick service can be rendered when special pipe jobs are required; also that gas welded bends, offsets, tees and crosses are dependable in service. Breakages in handling are unknown.

Fig. 2—Templets for Making 45° Cuts

The superintendent of the street main came into the pipe welding shop on a Friday and sketched on the floor a 16-inch pipe offset bend imperatively needed the next day. The head welder immediately started on the job with a cutting torch, cutting the required sections from lengths of 16-inch steel pipe in stock, using the templet shown in Fig. 2 for 16-inch pipe to lay out the angles. He cut off the short run to an angle of 22½ degrees, and then cut another piece 22¾ inches long with the same templet, adjusting it so that the high point of the cut was opposite the low point of the cut at the other end. The middle portion was cut for an offset run of about 30 inches, also using the same templet for the angle. These operations were continued making five pieces to be welded together.

In passing, note the fact that when making a 45-degree bend the templet to be used for making the cut is 22½ degrees. Both ends having the same angle of cut match all around when fitted together and produce an included angle of 45 degrees. This rule applies to all welded bends, the angle of cut on each piece being one-half the included angle between the pipe components.

Fig. 3—Welding Reinforcing Strap

When making the angle cuts the operator marks the high and low points of the templet on the pipe these being the matching points when joining two angle cuts. See Fig. 4.

In making up pipe bends and other combinations that can be effected with the cutting and welding torch, the operator is confronted with the difficulty of weld preparation, or that of making sound welds without proper preparation. When a pipe is cut off at an angle for a bend the cuts are generally made straight through, whereas they should be beveled to an angle of approximately 45 degrees. But if this be done consistently it means that the mating piece must also be beveled which generally means a second cut with the torch. Thus pipe is wasted and more gas consumned in cutting.

The general practice on standard weight pipe seems to be to make the cuts straight through, and tack the pipe bend components together with about ¼ to 5/16 inch open space between. The weld can be made with thorough penetration to the bottom of the joint but greater care and skill are required. More gas is required for welding, following this procedure than if the edges were beveled, inasmuch as the edges must be broken down

with the torch to form the vee in which the weld metal is deposited. However, considering all the advantages and disadvantages the square edge practice seems to work out generally with fair satisfaction, notwithstanding it is not in accordance with sound welding principles.

Welding the offset bend shown in Fig. 1 was done as an emergency job, started in the forenoon on Friday and needed the

Fig. 4—Marking and Matching Preparatory to Cutting

next day. The fabrication and welding were continued through the night and finished the following day at about 11 o'clock, making the total working time about 35 hours. The total consumption of oxygen for welding and cutting was 550 cubic feet, and acetylene 395 cubic feet.

The Iroquois Gas Corporation reinforces pipe angle welds like these with straps laid on the inside and outside of the angle. These straps, eight in number on the offset bend, considerably increased the time of welding and gas consumption. They are considered highly desirable where pipe bends are subjected to severe expansion and contraction stresses, it not always being feasible to introduce expansion joints in street main construction at the strategic points.

Fig. 5 shows a double pressure reducer and regulator used for reducing natural gas pipe line pressure from say 60 or 70 pounds down to a house pressure of 4 ounces. The regulator on the left is the high-pressure regulator connected to the gas main. This discharges into a pipe receiver made by welding heads on an 18-inch length of 4-inch pipe maintaining a pressure of about 6

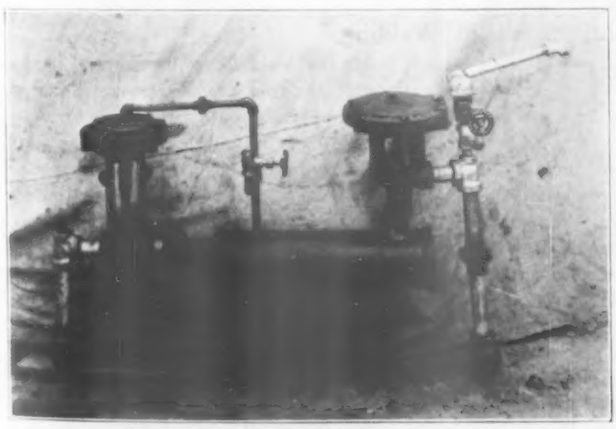

Fig. 5—Pressure Reducer and Regulator with Welded Pipe Receiver

pounds. The regulator at the right is the low-pressure regulator feeding the service line to the house. The pipe receiver between the regulators eliminates fluctuations of house-pressure which would be inevitable were the gas fed directly from one regulator to the other without volume capacity between.

The pressure reducers are standard equipment and the combination required for house service from a high pressure line is effected with screwed and welded pipe which can be made up on short notice when required. The assembly has fewer screw joints liable to spring leaks than an all screw joint job. The inventory burden and stock keeping costs too are kept down, which also applies to the general line of pipe line supplies to which gas welding is applied for assemblies.

NEW PORTABLE ARC WELDING MACHINES

The Wilson Welder & Metals Company, Inc., Hoboken, N. J., has recently added to its line two new arc welding machines, one a gas-driven machine and the other a motor-driven machine.

The motor-driven unit is for single operator, designed for rapid work with electrodes up to ¼ in. in diameter. The generator is of the field control type with a range of current adjustment from 75 to 250 amps. The adjustment is spaced in small steps and any desired value is secured through manipulating the knob of the field rheostat. The manufacturers maintain that this regulation is so close that welding at full load does not entail a rise in current of more than 10 per cent on short circuit. Ballast resistors are not used and the windings are of low resistance, so that

New Wilson Portable Arc Welding Machines

the generated voltage is that of the arc plus the drop in welding leads. The manufacturers also point to properly proportioned reactance which steadies the arc under all welding conditions, and makes for ease in starting and maintaining the arc. The panel of this machine carries a standard voltmeter and ammeter, a field rheostat, and a two-pole, double-throw switch to reverse the polarity of the welding leads.

The gasoline engine-driven is equipped with a four-cylinder 15 hp., Le Roi gasoline engine, of 1500 r. p. m. velocity. It has an automobile type carburetor and high-tension magneto. Gasoline consumption is estimated to be ½ gal. per welding hour at 200 amp.

The Department of Commerce, Washington, in a bulletin released January 24, reveals the fact that shipments of steel furniture stock goods for the year 1924 amounts to $17,381,252, an increase of $5,047,223 over the year 1923 and an increase of $6,486,049 in 1919.

The Welding Equipment & Supply Company, Kankakee, Illinois, has recently made arrangements to handle the Rego line of welding and cutting equipment. The Kankakee concern also carries a complete line of rods and gas.

The Welding Engineer

Founded by L. B. Mackenzie, 1916

Reg. U. S. Pat. Office.

Published on the 17th of Each Month by

THE WELDING ENGINEER PUBLISHING CO.,
608 S. Dearborn St., Chicago, Ill.
Telephones Wabash 7134 and 7140

G. H. Mackenzie.....President and Treasurer
W. W. Brothers.....Secretary

W. W. Brothers.....Editor
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Subscription payable in advance and postage free.
United States and possessions and Canada.....$3 a year
Foreign Countries.....$4 a year
Single copy, domestic.....25 cents
Single copy, foreign.....30 cents

Entered as second-class matter January 20, 1916, at the postoffice at Chicago, Illinois, under the act of March 3, 1879.

The Welding Engineer is a member of the Audit Bureau of Circulations and of the Associated Business Papers, Inc.

Last Advertising forms close at 8:00 a. m. on the 15th. To show proof for correction copy must be received at an earlier date and allowances should be made for delay to mails. All copy should be in by the 12th of the month at the latest.

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Another Source of Expansion

AN association of associations has often been talked of. Now it is a reality, for during the latter part of this month there will be a two day conference at which the executives of the various associations throughout the country will be present. This group will be known as "Association Executives Conference." They have many good speakers on the program and many vital subjects will be discussed. An association is beneficial to its members, that is taken for granted. This association should be equally beneficial to its members and to the welding industry, for we are represented by several active associations and societies. Why? Because there is an association for almost every industry. We wish to boost welding into the plumbing industry, the shipbuilding industry, the construction industry and various other industries, to a greater extent than it now enjoys. This group will furnish a splendid opportunity to do just this very thing. Every association should support it.

Mastering Welding

CONSTANT study, as well as hard work and long hours, is an essential factor in the development of welders today. More than ever before is it necessary that you know the fundamental principles underlying your work. Not so long ago, excellent advice to a young man about to learn welding was to direct him to the nearest job welding shop and tell him to stick to it for a year or more. This was very good advice too, for nowhere would he get such a variety of work as in the job shop. Now the situation is different. More of an understanding of the factors that actually enter into welding and cutting, by the different processes, must be had. It is not sufficient to know how a job must be done, one must also know why it is done that way, what the reasons are. This can only be mastered through study. Fortunately the welder of today can find plenty of worth while literature on the subject. His spare hours can thus be profitably spent in the study of his particular problems. After his own problems are thoroughly understood, he can then branch out and study the various welding practices and processes with which he is unfamiliar. Constant study is the really vital factor in the development of welding engineers. Welding engineers are in great demand today and will be in even greater demand tomorrow. People want to know just how welding will help them. It is not enough to merely tell them it will save them time and money and that they should use it. It is necessary for the welding engineer to draw plans and actually show how the use of welding can really help.

Railroads and Welding

ONE of the largest fields for welding is the railroad industry. Here the applications of welding are so numerous that they can well be called unlimited. This would be entirely true if it were not for the strict and useless limitations put on the car repair part of the program. These limitations are present because the repair shops throughout the country are not uniformly equipped. One shop can turn out all kinds of repair work satisfactorily, while many others with insufficient equipment can only turn out good work in a few instances. This has caused all of the railroads to play safe and limit the application of welding to certain jobs. Research and education is needed to expand the welding industry in this respect and progress is reported. However, in the reclamation plant, where old cars are cut for scrap, great strides forward have been made. The total amount of money saved in this way, annually, is staggering. This is also true in track work. Here the oxy-acetylene torch, the oxy-hydrogen torch, the electric arc and the thermit processes have been used extensively. Bolts on angle bars are rapidly and cheaply cut, while switch points, tracks and frogs are built up and repaired efficiently with welding. Welding has come into its own in railroad practice and the skilled welder will keep it there.

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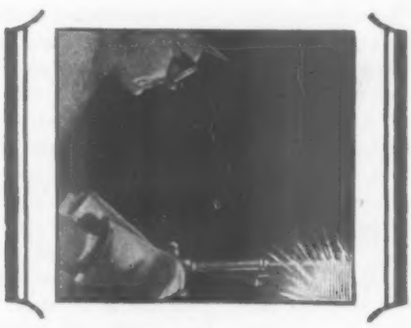

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Welding and Cutting in Railroad Shops*

The Fundamentals of Oxy-Acetylene Welding and Cutting in the R. R. Car Shop—Various Applications of this Process to Car Work

By W. H. Ludington

THE introduction of the oxy-acetylene welding and cutting torches into the car shops has greatly simplified and reduced the cost of the fabrication and the maintenance of rolling stock probably to a far greater degree than any other tools of comparatively recent development. Some of you will remember the introduction of pneumatic tools; most of you will remember your first impression of the field for operation of the oxy-acetylene welding and cutting torches and probably your highest expectations of their possibilities, at that time, have been more than realized in actual practice long ago.

Cars of steel construction are fast replacing the former wooden types, therefore, most of my remarks will refer to cars of steel construction such as the open hopper gondola types and steel frame box cars; in fact, there is a limited amount of cutting and welding that can be done around wooden car bodies other than the cutting of frozen bolts and nuts and the welding and cutting on the steel under-frames.

It is well to remember that the same care should be exercised with the oxy-acetylene flame as with any other flame when working around cars of wooden construction. Obviously, any cutting and welding around such cars should be done in the open as far as it is practical to do so.

Briefly, the application of the oxy-acetylene process to car work can be divided into the following four operations:

1. Cutting down steel cars for rebuilding.
2. Trimming of new sheets and burning new holes for application of sheets.
3. Cutting down of steel cars to scrap.
4. Reclaiming of car parts for re-use.

Oxy-acetylene welding and cutting operations in car shops involve the use of (1) oxygen, (2) acetylene, (3) oxygen regulators, (4) acetylene regulators, (5) oxygen hose, (6) acetylene hose, (7) welding torches, (8) cutting torches, (9) adding material (welding rod) and (10) goggles.

We will endeavor to present briefly information upon each of the above ten items which should allow you to consider oxy-acetylene welding and cutting operations with more interest.

(1) Oxygen, used for the oxy-acetylene welding and cutting industry generally, is produced from the atmosphere. The atmosphere is composed approximately of but 1/5 oxygen and 4/5 nitrogen. There is present in the atmosphere a number of rare gases such as argon, helium, neon, etc., but because they are present in extremely small proportions they are not factors in the commercial production of oxygen and we do not need to consider them further here.

We know that some substances will exist in three different states, namely, gaseous, liquid and solid, depending upon the temperature and pressures to which they are subjected, for instance, steam, water and ice are the gaseous, liquid and solid states of water. Scientists claim that all substances will exist in these three different states.

Means of reducing the temperature of air to the point where it will become a liquid have been developed through a mechanical process of refrigeration by compression, cooling and expansion which reduces the temperature of the air to approximately 190 degrees below zero C., at which temperature it takes the liquid form. Liquid nitrogen and oxygen have different boiling points and this characteristic allows the two gases to be separated and collected, the same as water and alcohol is by distillation. The separated oxygen is then released into a gasometer from which it is compressed into drawn steel cylinders, weighing approximately 125 pounds when empty at a pressure of 2,000 pounds per square inch, at which pressure the cylinder contains 220 cubic feet at 70 degrees Fahr.

The liquefying of air as described above requires extremely complicated and costly machinery and expensive operations, and as less than one-fifth of the volume of air treated is recovered as oxygen, its cost should be appreciated and it should be used economically.

(2). Acetylene gas is composed of carbon and hydrogen and is known chemically as an endothermic compound. It is the perfect fuel gas as both the carbon and hydrogen will combine with oxygen, readily resulting in rapid combustion producing the hottest flame than can be produced by the burning of gases. The temperature of the oxy-acetylene flame is computed to be about 6,300 degrees Fahr.

Commercially, acetylene is produced by slaking calcium carbide with water. Calcium carbide is produced by fusing together coke and lime in an electric furnace.

Acetylene gas cannot be compressed in a free state similar to oxygen. However, liquid acetone under pressure has the peculiar property that it will absorb many times its own volume of acetylene gas and acetylene thus dissolved can be safely held under pressure.

The acetylene cylinders used for convenient transportation of acetylene gas are constructed of a steel shell which has been completely filled with a porous filler. A predetermined weight of liquid acetone is first forced into the cylinder and then the acetylene gas is pumped into the cylinder and is absorbed by the acetone content. Acetylene gas thus compressed to approximately 250 pounds per square inch can be transported safely. The quantity of acetylene gas contained in the cylinder is not measured by the pressure shown by the gauge, but is determined by weight. The weight of the cylinder and acetone content are stamped on the cylinder and the difference between this stamped weight and the actual weight of the cylinder (plus contents) represents the weight of acetylene in the cylinder. One pound of acetylene is approximately equivalent to 14.85 cubic feet at 70 degrees Fahr.

It is because acetylene gas is a pure fuel that it is so valuable for oxy-acetylene welding and cutting, therefore, handle it accordingly. Store acetylene gas cylinders in a cool and well ventilated warehouse by itself and keep away all kinds of flame. Use it only with proper regulators, sound hose and approved torches. Remember that acetylene has a low ignition temperature and can be lighted from the lit end of a cigarette.

(3) Oxygen Regulator. Oxygen when received in railroad shops in cylinders has been compressed to 2,000 pounds per square inch as mentioned above. The pressure of oxygen required to operate standard welding and cutting torches is usually much below 25 pounds per square inch. Therefore, the cylinder pressure must be stepped down. This is accomplished by the use of the oxygen regulator. All regulators or reducing valves, for steam, water, oil or gas are practically similar in principle, consisting of a body, bonnet, diaphragm with stirrup attachment

Address by W. H. Ludington, manager of Railroad Engineering Service Department, Air Reduction Sales Co., before the Car Foremen's Association, January 6, 1925, at St. Louis, Missouri.

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controlling a seat and seat holder which closes over the intake. The movement of the diaphragm is controlled by a spring, the tension of which is regulated by a screw.

However, when regulating economically, oxygen with the intake pressure high and the outlet pressure low, also when a sensitive adjustment is necessary, the detail design, material and workmanship that go to make up the oxygen regulator takes on a real value. Oxygen regulators are equipped with two dial gauges to show the cylinder (intake) pressure and delivery (outlet) pressure to the hose.

Oxygen regulators are used as described above for reducing and controlling the pressure of pure oxygen. Oxygen will combine readily with any form of carbon, producing rapid oxidization, and if the carbon is in the form of oil or grease and if the oxygen is under pressure, this would result in an explosion. Therefore, never use any oil or grease, dirty waste or greasy gloves around an oxygen regulator or oxygen cylinder. Keep all oil or grease away from pure oxygen. Never test an oxygen regulator with an oil gauge. Use soap suds for locating leaks.

(4) Acetylene Regulators. The function of acetylene regulators is the same as the oxygen regulator, namely, to reduce the acetylene cylinder pressure, of approximately 250 pounds per square inch to usually less than 15 pounds per square inch. Acetylene does not present the same hazards when brought in contact with oil or grease as does oxygen, but acetylene gas is a pure fuel and can be ignited very readily, therefore, keep all flames away from the acetylene regulator. Do not hang a lighted torch near the oxygen or acetylene cylinders. If, due to any cause, a flame is observed near an acetylene regulator, promptly turn off the acetylene cylinder valve.

When one stops to consider the big range of regulation of oxygen and acetylene regulators, namely, from 2,000 pounds and 250 pounds per square inch, respectively, to less than 25 pounds per square inch, in both cases, one will realize the severe conditions under which these regulators must function. In addition to this a sensitive regulation is necessary in order that the proper neutral flame can be maintained. Therefore, remember that in view of the demands made upon the oxygen and acetylene regulators, they should receive considerably more care in handling and adjusting than such equipment as pneumatic tools. Also when the complete welding and cutting equipment, consisting of cylinder, regulators, hose and torches are transported from place to place in a shop on trucks, all unnecessary jars should be avoided. The adjusting screw on both oxygen and acetylene regulators should be released by turning the adjusting screw to the left after opening the torch needle valves, in order to relieve the tension on the diaphragms of the regulators.

(5) Oxygen Hose. The function of the oxygen hose is to convey the oxygen from the outlet of the oxygen regulator to the inlet on the welding or cutting torches. According to our standard practice and instructions, all oxygen hose must be black in color. The oxygen hose should be examined carefully for leaks in order to avoid unnecessary waste.

(6) Acetylene Hose. The function of the acetylene hose is the same as that of the oxygen hose, namely, to convey the acetylene gas from the outlet of the acetylene regulator to the inlet on the welding or cutting torches. According to our standard practice and instructions, all acetylene hose must be red. Similar to oxygen hose the acetylene hose should be examined carefully for leaks in order to avoid unnecessary waste and hazard.

In the case of both oxygen and acetylene, the gases are of too much value to be conveyed in hose of questionable quality. The service to which oxygen and acetylene hose is subjected is necessarily severe in the boiler shop, and weak, worn hose should not be tolerated.

Important. In the case of both oxygen and acetylene, the pressures, at which the gases are contained in the cylinder, are far in excess of the pressures for which the hose is designed, and to attempt to connect either oxygen or acetylene hose directly to the tank, omitting the use of regulators, would result, in all probability in the hose bursting and causing possibly serious damage, due to the large volumes of either oxygen or acetylene which would be released at high pressures.

(7) Welding Torch. The function of the welding torch is to mix thoroughly approximately equal volumes of acetylene and oxygen and to deliver the same at the tip of the torch so that when ignited it will produce the correct welding flame which is chemically neutral.

(8) Cutting Torch. The function of the cutting torch, in addition to mixing all of the acetylene delivered with an approximately equal quantity of oxygen delivered, is to deliver this mixture to the preheating holes in the front end of the torch, in order that the necessary preheating required for cutting can be obtained with the preheating flames. In addition to this, necessary quantity of oxygen at the proper cutting pressure must be delivered into a cutting jet in the center of the tip at the end of the torch, at the correct pressure, and a standard cutting torch is designed so that this cutting jet of oxygen can be turned on and off almost instantaneously.

The standard welding or cutting torch is simply a tool to facilitate the control of oxygen and acetylene in the quantities and at pressure necessary to enable the operator to do oxy-acetylene welding or cutting as required. While the standard welding or cutting torch can be considered substantial in construction, we must remember that the weight of these torches must be limited, in order to allow the operator to manipulate the same with the proper easy movement necessary to obtain the best results.

In the case of the welding torch, the movement must be continuous and over a restricted area, therefore, a heavy torch would prove cumbersome.

In the case of the cutting torch, the torch must be manipulated with a tip, close to the work and specified peripheries must be reasonably closely followed, therefore, the torch must not be too heavy in construction. However, both in the case of welding and cutting torches, the construction of standard makes can be considered substantial, but these tools must receive more careful handling than pneumatic tools.

(9) Adding Material. The welding in the boiler shop is confined largely to welding together boiler plates, such as in the case of putting in new half or three-quarter side sheets, door sheets, and flue sheets, in addition to the higher physical characteristics to be found with good welding rod, the proper analysis and purity of a good rod make an extremely clean puddle. Good welding rod will flow at just the right fluidity, facilitating greatly the work on both horizontal and vertical seams to the end of permitting the operator to work much faster without any harmful effects upon the weld resulting, with economy of labor and gases.

The physical characteristics of a welded joint depend largely upon the quality of adding material used, because remember that any two sheets of metal welded together are entirely separated by the adding material in the weld. In other words, the strength of any welded joint cannot be more than the strength of the adding material after it is fused into the weld. Therefore, when considering adding material remember that it is the strength of the welding rod, after it has been fused into the joint that really counts, and not the strength of the adding material before it has been fused into the joint.

It is folly to attempt to make a sound weld with inferior adding material and assuming that the resulting weld is good enough, it requires an additional quantity of oxygen and acetylene to turn out some of the impurities and the cost of the additional gases used is out of proportion to the few cents a pound that might have been saved at the time of purchasing this cheaper material.

(10) Goggles. Oxy-acetylene welding operators are required to watch closely the manipulation of the oxy-acetylene flame and its influence upon the sheets being welded and resulting puddle created by fusing the sheet together and the introduction of adding material.

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While the manipulation of the welding flame comes to be second nature and purely muscular movement on the part of the operator the feeding of the adding material into the weld and maintaining the size of the puddle require close and continuous observation by the operator and, therefore, the matter of proper goggles to protect the operator's eyes is most important.

The welfare of efficient and competent welding operators cannot be neglected. The rays from the oxy-acetylene flame are the same as those emanating from the sun and are very intense. To observe directly the oxy-acetylene flame is the same as looking directly into the sun. There are two injurious rays to be guarded against, namely, the infra ray, which sun burns and the ultra-violet (X-ray). The welding goggles put on the market by responsible concerns, are fitted with lenses which exclude both of the above rays.

Oxy-acetylene cutting operators must observe closely the contour which they are cutting and follow this contour progressively with the preheating flames which offer the same conditions, but to a less degree as the oxy-acetylene welding flame and, therefore, the cutting operators should be equipped with proper goggles. However, the goggles used for cutting, in view of the smaller size of the preheating flame, as compared with the welding flame, can be of lighter shades than the welding goggles, but the lenses should be of such optical value as to exclude the harmful rays mentioned above.

Of course, in all mechanical operations, the proficiency of mechanics will vary within broad limits, but remember that in the case of an inefficient welding or cutting operator, in addition to the cost of the time of such operators, must be added the cost of the oxygen and acetylene and in some cases valuable locomotive hours.

While realizing that the choosing of welders is limited by some labor regulations, the above factors should be considered and decisions made accordingly when conditions will allow.

Having described the apparatus and equipment employed, I will cover briefly the field—first, for oxy-acetylene welding operations and second, for oxy-acetylene cutting operations.

Welding

The principle of welding employs the extremely high temperature of the oxy-acetylene flame to fuse metal parts which are to be joined and to melt into the weld such additional metal as may be required to give greater strength. Also metal in specific cases can be added to certain worn surfaces thus regaining the original dimensions and in this respect the operation of welding is most unique as it is the only means of putting on metal.

Your experience from day to day in your shops readily indicates to you that a great many very heavy sections must be scrapped and replaced simply because comparatively small wearing surfaces have worn down to such limits that the parts must be replaced. For instance, consider the number of axles that would be scrapped if it were not possible to economically build up axle collars after they have worn down beyond the legal limit. Welding alone has made this class of reclamation possible.

Also the failure of certain members of cars which develop cracks due indirectly to fatigue and shock creates a tremendous field for comparatively small welding jobs to reclaim these members with a tremendous saving in time and material instead of the original method of expensive replacement. Among the more important members I might mention:

Bolsters, Body Stiffeners, Side and Center Sills, Passenger Car Face Plates, Passenger Car Diaphragms, Transoms, Truck Oil Boxes, Costs, Braces, Stakes, Draft Castings, Truck Sides.

In the case of truck sides, in addition to the welding must be considered preheating and annealing as specified by the M. C. B. rulings, which also specifies, truck sides with fractures in tension members must be dismantled.

Experience would indicate that the fractures in truck sides, without touching upon the primary cause of the breaks, showing up fractures in periods of from three to five years after the car has been in service and this time interval indicates that the factor of fatigue along with the primary cause resulted in the fracture. Therefore, it does not seem reasonable to include all the cost incidental to dismantling, preheating and annealing after welding to the actual reclamation of the truck side in question because this phase of the operation will eliminate the primary cause in the majority of cases which resulted in the original fractures. As a matter of fact, truck sides properly welded and annealed are in better condition than when originally applied to the car. Of course, this class of reclamation must be done strictly in accordance with the M. C. B. rulings and only truck sides which are permissible under these rulings should receive any consideration.

On account of the difference of the practices in shops the cost data on specific jobs would not serve as an indication of the possible economies that can be effected with the welding torch in railroad shops. The wide discrepancy between the different costs recorded is due largely to the proficiency and intelligence of the operator, the facilities available and the supervision exercised.

The most satisfactory method of estimating the cost of welding jobs is to compute the cost in terms of pounds of metal added and while this will vary widely and will apply only to average operations, the following figures will serve as a basis:

Cast Iron Welding	$ .50 to $1.00 per pound
Brazing	.80 to 1.20 per pound
Steel Welding	2.00 to 2.30 per pound

In the case of worn axle collars, the cost will approach the maximum for steel welding, because there is a heavy section to be heated although the actual amount of metal added is comparatively small. Also if a proper annealing furnace is provided and the axle collars heated up by this means, the cost of preheating is saved many times because the oxygen and acetylene consumption is used almost entirely for melting and fusing the material added.

There are, of course, a great many reclamation jobs possible with the oxy-acetylene process which, to be economical, must be handled to some extent upon a production basis as the costs for a single operation would not prove economical. Among these we might mention:

Worn Couplers, Knuckles, Pins, Locks, Lifters, Showers, Equalizers, Westinghouse Draft Gear Links, Truck Sides and Axle Collars.

The welding torch can also be used to advantage for local heating when peculiar conditions do not allow for the heating up with a cheaper fuel such as oil, for such cases as the laying up or forming or straightening the sections of plate, angle iron and rods on cars under repair or construction.

Cutting

The cutting torch provides a convenient and economical means for removing such parts as plates, rivets, bolts, nuts, etc., and for such operations as piercing of angles and plates. Also old center sills can be easily cut with the torch, spliced plates applied and holes cut in the sills to line with those in the plates. An operation of this kind may require only ten or fifteen minutes with a torch, while the alternative method of sawing and drilling would easily require two hours. Coping irons when badly bent can easily be cut out, straightened and welded back into the plates.

The operation of cutting down cars for rebuilding and cutting down for scrap are practically the same but I fear that in many cases the cutting down of cars to scrap does not receive the attention it should due largely to the fact that the scrapping of cars is considered as a necessary evil. However, the normal operation of a railroad comprehends the scrapping of a number of cars annually and since this is a normal operation any economy that can be effected on this operation will directly reduce the operating costs.

The size, type and condition of cars will vary widely when scheduled for the scrap dock and therefore, it would be difficult to get anything but an estimate cost per car which would be

(*Continued on page* 40)

Arc Welding in the Steel Industry*

Where the Electric Process Is a Great Salvaging Agent—"The Iron Worker's Needle and Thread"

By W. L. Warner†

THE art of welding is old but electric arc welding as a science is a comparatively recent development within the past two decades. Heat is generated by an arc which is formed by a gap in an electric circuit. The heat of the arc causes fusion to occur between the parts to be welded and metal is generally added from an external source to complete the weld. Certain kinds of metal can be deposited with the electric arc under suitable conditions. Sheet steel a sixteenth of an inch thick or a break in a large casting may be welded with the electric arc. In either case the capability and experience of the operator affect to a great extent the quality of the finished job.

In the steel industry the opportunities for utilizing the electric arc in repair work and for salvaging worn parts are very numerous. They are more numerous, in fact, than we perhaps at present realize. The product is steel and steel machinery is the necessary equipment for this manufacturing process. Breaks will occur under the severe service required and certain parts are very quickly worn sufficiently to require replacement or repair. In most cases, it is of prime importance to avoid delay or inactivity as idleness costs real money in a steel mill. The shut-down of one part of a mill usually means a cessation of activities of the whole mill.

However, it must not be supposed that all machinery parts are allowed to wear out before replacement. In fact, whenever excessive wear on any part is noticed, a new part or one previously repaired by welding may be inserted, thus avoiding undue strains in various parts of the machinery caused by a sudden failure of one part. Practices vary, however, in different respects in the various steel mills throughout the country.

In the brief discussion given above, the writer does not mean to infer that failures of parts of a steel mill are necessarily repaired on the spot by electric arc welding or that the savings effected by the electric arc are primarily achieved in this way. In fact, many repairs which are made by electric welding require a longer time than would be required to put a new part in the place of the one which is broken or worn out. But, if new parts were inserted for broken ones every time failure occurred, the cost would be enormous. However, broken parts can be salvaged with the electric arc in the welding shop and be put back in service again with a cost much less than the cost of a new part.

Spindles

Even if it were possible to carry a sufficient stock of new repair parts to keep the mill in continuous production, the cost of replacement would be staggering. The electric arc welding process will cut maintenance costs tremendously and in varying degrees depending on the class of work done.

Probably the most universal repair which is at present done with the electric arc is the building up of worn wobblers on mill pinions and spindles. Some welders "peen" the deposited metal as each layer is added while others do not. In some cases the outside layer is put on of manganese steel so that a manganese content of probably from 10 to 12 per cent is obtained. In this way the length of service obtained from the repaired wobbler is greater than the original new part can give. This difference, of course, varies depending on whether the spindle or pinion is of forged or cast steel. In one instance, the writer found that new wobblers lasted about three months in service, while welded wobblers lasted over six months. This item is worth considering.

This saving effected by welding over replacement by new parts may be considered in a different light when it is known that the repair of worn wobblers by welding costs between $30 and $100, while the cost of a new spindle or pinion is from $1,000-2,500. As an illustration, an actual case may be cited in which a spindle 22½ ft. long and 16 inches in diameter at the center was repaired by arc welding. The jaws of the wobblers were 8 inches deep, 8 inches wide, and 12 inches long and were worn on each side because the spindle had been reversed while in service. In this case, therefore, 16 jaw sides were built up and approximately 85 lbs. of electrode material was used. The total cost was about $51, while the cost of a new spindle would be about $2,000.

Let us consider the table rollers. There seems to be a considerable saving effected not only in the manufacture, but also in the maintenance of the cast steel roll. Blow-holes occur in the roll surface or defects exist in the bearing surface. Either the metallic arc or the carbon arc are used for filling up these blow-holes. While in service, the roll pinions sometime crack, some teeth break out, or the pinion breaks loose from the roll entirely. These types of failures are easily and cheaply repaired by electric arc welding. The writer was told by one welding supervisor that welded table roller bearings last about six months longer than new ones.

Sheet Mill

One instance of the savings effected by electric welding may be cited in the hot sheet mill where several cast steel roll housings have broken and been successfully welded with the electric arc. These housings weigh from 15 to 16 tons and cost about $3,000 when new. The average cost of repairing the fractures was about $537 each and in one case it was stated that 12 of these housings in one mill are welded and in service at the present time. In this case alone, the use of arc welding effected a clear saving of approximately $30,000. This amount certainly more than paid for the first cost of the welding apparatus required to do the work.

In the hot sheet mill, the roll train rider ears slide in guides which confine the rider to an up and down motion. The ears wear thin after a length of time and must be thrown away, unless the original thickness can be restored. This has been successfully done with the electric arc. On the average a pad of metal about ½ inch thick must be deposited on each ear. The ears are about 8 inches long and 3 inches wide. Between 3 and 4 of these riders can be welded in 10 hours, using between 11 and 13 lbs. of electrode material. If the deposited metal is built up exactly to size and hammered thoroughly, no machine work is necessary as a hard smooth finish may be obtained without machining. If machining is resorted to usually about 6 riders may be completely ma-

*Presented December 12, 1924, at the Pittsburgh session of the Association of Iron & Steel Engineers.

†Industrial Engineering Dept., General Electric Company.

chined in two hours. The average total cost of making the repairs necessary is about $3.25 per rider. This figure will vary, depending on the amount of wear and the size of the rider ears. This is a great saving.

In the hot sheet mill also there are annealing furnaces used for bringing the sheets up to the proper temperature for rolling. The sheets are passed slowly through the furnace on water-cooled disc rollers, which are slowly turned by machinery external to the furnace so that the sheets of steel are thoroughly soaked with heat. It has been found that the disc rolls frequently burn through because of air pockets which have formed inside of the discs due to their rectangular cross-section. In order to avoid this condition one welder devised a new type of roll made of standard pipe made up in a spiral form with the connections welded. Several furnaces have been equipped in this way and are in satisfactory operation without any failures to report although this operation has not been of sufficient length to prove conclusively that the new rolls are an improvement over the old ones. These new rolls are a distinct departure from the former type of disc rolls and it is believed that due to the nature of the construction, these rolls will long outlast the previous type of disc rolls.

Another piece of machinery which sometimes breaks is the plate shear in the sheet mill. The writer has seen a large shear on which one end of the head was cracked for about 14 inches. This crack was welded with the electric arc. The shear is now in continuous operation with no further signs of failure.

In the strip mill we find the electric arc used for building up the bearings or repairing cracks in table rollers. These welded rollers are stated to give over six months longer service than new rollers. In some cases, the strip mill guides, whether of rolled, forged, or cast steel are arc welded throughout.

Blooming Mill

Some parts of the machinery customarily found in the blooming mill, bar mill or structural mill are economically repaired with the use of electric arc welding. Certain parts such as wobblers and table rolls have been mentioned. The gear pinions for the manipulators or the strip mill pushers are easily and economically repaired and put back into service. In one instance, a fifteen toothed gear has had eight teeth built in by arc welding and is in service at the present time. The screwdown for the blooming mill sometimes needs a thread built up or some of the teeth in the gears have broken out. Repairs of this nature are easily and quickly made with the electric arc and the repaired part is ready for further service instead of the scrap pile.

Sometimes a main roll bearing cracks or the lugs are broken off. Instead of scrapping the bearing, repairs can easily be made with the electric arc and the bearing may be put back in service. Cracked bearing housings and spindle couplings may also be returned to service in a similar manner.

The modern trend toward electrically driven rolling mills and accessories has necessitated a large number of small motors for operating steel mill accessories. In most cases, these motors are situated in the mill adjacent to the apparatus operated by them and are subject to very severe service. Usually, there is no careful inspection of these motors maintained, except to take up the bearings sometimes when the motor vibrates excessively. The mill operates until a motor fails either due to a worn commutator, worn shaft, or a burned out armature or other causes. Perhaps the bearings need rebabbitting or the shaft is worn so that the bearings cannot be tightened any more. At any rate, the motor is replaced by a spare and the mill goes on rolling steel. But what happens to the motor which has just been replaced? It is sent to the electrical repair shop.

In the repair shop, the motor is dismantled and if the armature is burned out or the field coils injured, new windings are put in. Sometimes only the shaft is worn and a new one is inserted or the old one is repaired by depositing metal on the worn spot with the electric arc. The rebuilding of worn shafts by the automatic arc welding process is a simple every day proposition as shown by Figs. 1 and 2.

In Fig. 2 is shown the armature shaft of a 2500 KW generator which has been built up in this way and machined to size. The weight of this armature is 12,000 lbs. The welding and machining was done without removing the shaft from the armature. This application of arc welding represents a considerable yearly saving not only by salvaging the worn shafts, but also by speeding up the repair work which eliminates the necessity of tieing-up a large amount of money in extra spare parts.

In the case of the steam driven rolling mill, the crank shaft of the motor might break as shown in Fig. 3. Fig. 4 shows the broken crank shaft, completely repaired with the electric arc process. While a break of this character is probably a rare occurrence, nevertheless the use of the electric arc welding process will save considerable time and money should the need arise. The many details which must necessarily be considered are partially illustrated in Fig. 3. This shaft must necessarily be very carefully lined up prior to welding and it was absolutely essential that this accurate alignment be maintained during welding and until the weld had cooled.

Foundry and Furnaces

In the open hearth furnaces, foundry, and blast furnaces, arc welding is of valuable assistance. Water coolers for the open hearth furnaces are constructed in some cases by simply welding a strip of sheet steel of the proper width across the front of a structural channel, thus forming a water tight chamber of approximately a rectangular cross-section. Small pieces of sheet steel are welded to the ends closing the openings. Pipe connections are welded into the ends so that water can be circulated through the chamber. This method of construction lends itself readily to any size of water cooler which may be required.

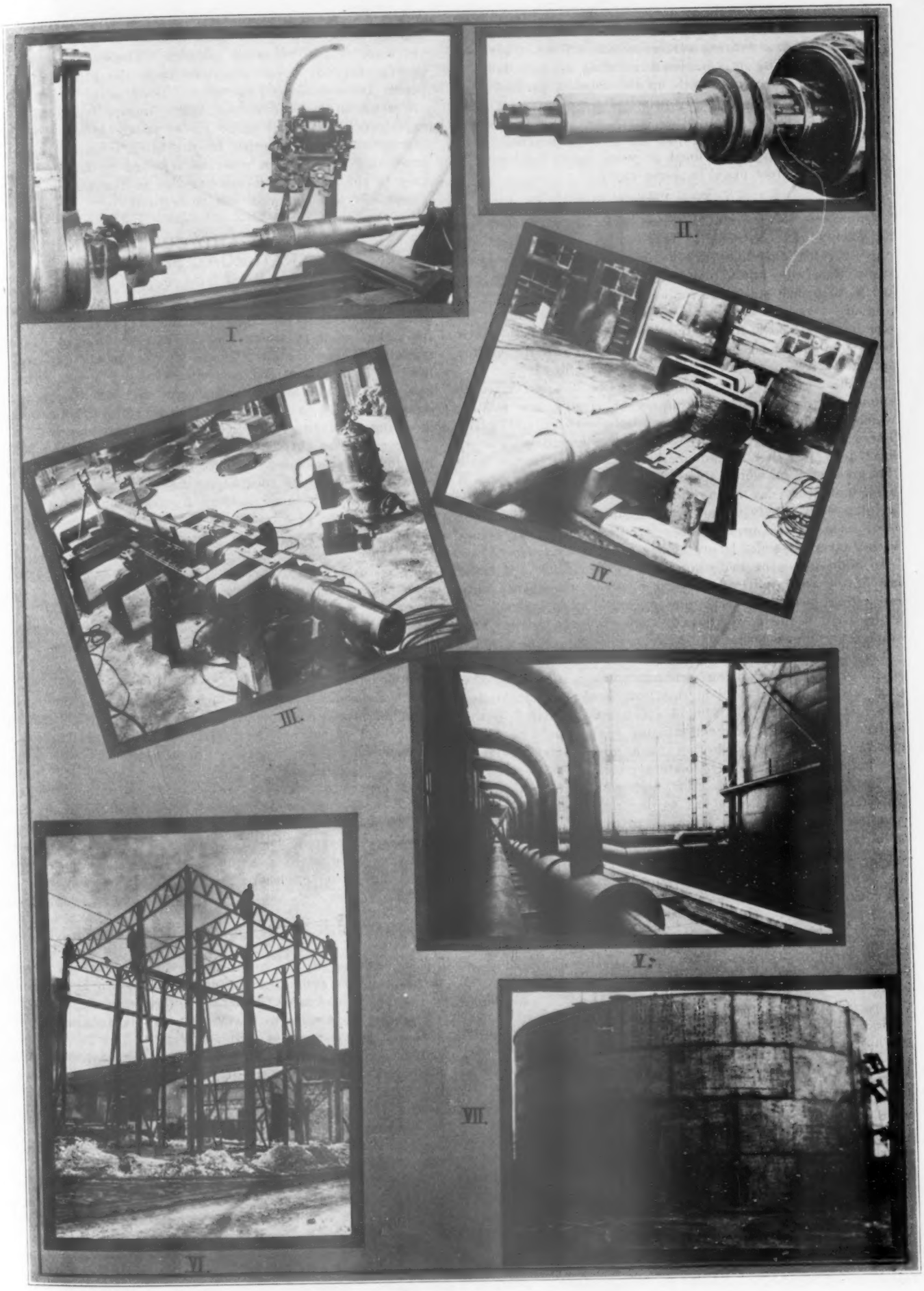
It sometimes happens that the peel of the charging carriage breaks. A new peel may be inserted and the broken one repaired in the welding shop. Breaks in the gears or travel mechanism of the charging carriage may be also repaired by welding. Sometimes the doors of the open-hearth furnaces develop cracks which are easily and quickly repaired with the electric arc.

For repairing defective castings in the foundry, the electric arc is of great assistance and many thousands of dollars are saved each year by its use for filling blowholes and building up undersized parts. The electric arc also offers many inducements for cutting up steel scrap for charging the cupola or removing risers from steel castings.

Transportation System

The maintenance of satisfactory transportation facilities between buildings and departments demands a certain amount of study. Most every steel plant maintains a more or less complete steam railroad system for moving materials from place to place. The locomotives require periodic inspection and repairs. New flues must be inserted or a new flue sheet put in. A crack in the fire box must be repaired. Perhaps there is a broken frame to be repaired. Electric welding will make the necessary repairs with a small expenditure of time and money. Worn motion parts may be easily built up to the proper size with the electric arc. New journals may be installed or the old ones repaired. The electric welding arc is indispensable in the locomotive shop. Frequently repairs can be made without the necessity of any dismantling, thus shortening the time of idleness of the locomotive.

Track maintenance and upkeep of yard cars also is of some importance in a steel mill. Switch points, cross-overs,



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and frogs are easily built up to proper size. A rod of about 12 or 13 per cent manganese content is sometimes used in order to obtain a wearing surface which will resist abrasion. After the welding is completed grinding is sometimes resorted to in order to smooth up the wearing surface. Rail bonds are quickly and easily attached by electric arc welding. Car couplings and journal boxes are sometimes welded and put back in service without any appreciable cost. Worn journal boxes may be relined or worn spots reinforced by putting on a steel plate in some cases.

Pipe Lines

Oftentimes leaks occur in water or steam lines which can be quickly and conveniently repaired by electric arc welding. Welded pipe lines can be installed more cheaply and easily than any other type of jointed pipe. In one case 400 ft. of 6 inch steel pipe for a water line carrying 400 lbs. pressure was successfully installed in a steel plant. The pipe lengths were 20 ft., and the thickness of wall was ⅜ inch. East joint was beveled at 45° and welded with the electric arc. The cost per joint was approximately $1.55.

In the foregoing discussion the writer has attempted to enumerate the various applications of electric arc welding which may be found in and around the average steel plant. There are probably some which certain ambitious welders have developed that are not mentioned here, but in the main the great use to which the electric arc welding process is being put every day in the steel mill shows that electric arc welding does satisfy a universal demand. This process has been termed "the iron-worker's needle and thread, a universal saver of time, labor, money, and materials."

In addition to the many applications of electric arc welding in the steel mill where steel is made, there are many interesting instances where the process may be advantageously used in the fabrication of steel products. A few examples are given below.

Fig. 6 shows a structural steel framework 40 ft. high and 40 ft. square erected using welding in place of rivets. The total weight of steel used in this framework was 39,534 lbs. The cost of erection was $105.75 and it was estimated by the builder that the cost of erection using rivets would be about $197.75. These figures do not show the savings in labor and materials gained by eliminating punching of rivet holes.

Fig. 7 shows an oil tank 20 ft. high and 43 ft. in diameter. This tank was completely arc welded throughout and when completed was filled with kerosene to test for leaks. After 36 hours of test no leaks appeared.

Fig. 5. shows the arc welded pipe connections between the gas generators and a collector header at a municipal gas plant. The upright pipes are 20 inches in diameter and the header is 28 inches in diameter. A considerable amount of this type of construction is sometimes used in gas generating plants.

There are several reasons why the electric arc welding process should be considered for general repair work in the average steel plant.

First, the use of electric arc welding eliminates the necessity of tying up large amounts of working capital in new spare parts.

Second, the use of electric arc welding decreases the cost of replacement to a very great extent. In many cases the worn-out part can be rebuilt at a fraction of the cost of a new part and the amount of service obtained from the part so rebuilt will be equal to and often greater than the amount of service obtainable from a new part.

Third, the use of electric arc welding eliminates considerable delay in making repairs or replacements.

Fourth, the electric arc welding process is successful when handled by an experienced welder operator.

In general the writer has endeavored to show the wide range of opportunities offered for using electric welding. While the possibilities of electric arc welding are now becoming recognized by the steel industry to a certain extent, yet there is still room for advance. The expansion of the process depends to some extent upon the supply of competent and experienced operators. Good sound strong welds are required because of the heavy service which must be experienced in a steel mill. Every failure means a loss of money and the executive in the steel industry is rather cautious. This caution must be replaced by confidence not only in the welding process but also in the welder himself. Eventually this condition will be realized.

WELDING AND CUTTING IN RAILROAD SHOPS

(*Continued from page* 36)

between $8 and $20 depending upon the balance of the foregoing conditions. Other important factors, of course, will be the classification to which the car will be scrapped. In the majority of cases the car is simply scrapped by the Car Department to loading sizes and later this scrap is cut into charging box sizes by the Stores Department. Nevertheless, since the scrap is credited to the Car Department indirectly, the cost of producing is of direct interest to the Car Department.

For estimating purposes, the cost of 3½c to 4½c per linear foot for cutting required to reduce the car to loading sizes would allow you to estimate roughly the cost of scrap cutting. This figure, however, is based upon using oxygen and acetylene as a fuel gas and the best results will be obtained by using oxygen of high purity with acetylene as the fuel gas.

The time required for cutting down a car for scrapping will vary from five to eight hours depending upon the factors mentioned previously. This does not, however, comprehend, salvaging any parts of the car for further use.

The consumption of oxygen and acetylene is the main factor affecting the economy of the oxy-acetylene process for scrapping cars. You will realize the necessity for a careful study of the operating pressures and sizes of tips best suited to this class of work. In addition to standardizing these factors the human element is involved to a large degree and you will find that the closest kind of supervision is needed to enlist the interest of the operators so that the rules of strict economy will be observed at all times.

The number of operations in welding and cutting generally carried on in the Car Department is so small by comparison with the possible number, that every Car Foreman should make it a point to exercise honest economy in the way the present operations are done so that additional ones can be undertaken, thus giving greater production per 100 cubic feet of oxygen.

DETROIT SECTION OF AMERICAN WELDING SOCIETY

A local section of The American Welding Society was formed in Detroit on the evening of Tuesday, February 3rd, at a meeting held at the Union League Club at which there were eighty present, representing all branches of the Welding Art and Industry as used in Detroit and contiguous territory.

Mr. E. H. Ewertz, General Plant Manager, Bethlehem Ship Building Company, Elizabeth, N. J., who is President of the American Welding Society, and Mr. H. S. Mann of the Metal and Thermit Corporation, Chicago, who is Vice-President, covering the mid-western division, were present, in addition to Mr. C. A. McCune, Page Steel & Wire Company, who is National Treasurer and chairman of the Membership Committee.

After talks by the above mentioned gentlemen and by Mr. H. M. Gould, Assistant General Manager of the Detroit Street Railways, explaining the aims of the society and the benefits accruing to members, an organization was completed.

A film, loaned by the Oxweld Company, was then shown illustrating the method used by many in repairing defective castings, both small and large and also the cutting process used in reducing

large metal objects, including battleships, to a size that can be readily handled.

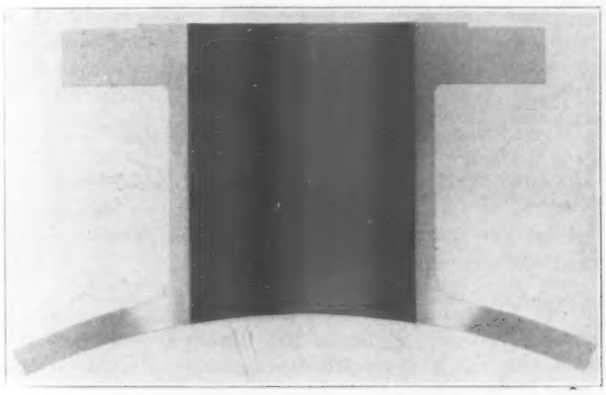
The following officers were elected for the Detroit Section, to serve one year:

Chairman—H. M. Gould, Asst. General Manager, Dept. of Street Railways. Sec'y & Treasurer—C. L. Finch, Detroit Range Boiler & Steel Barrel Co. Chairman Membership Committee—O. L. Smith, Weldit Acetylent Co. Chairman Charter Committee—S. H. Calender, Air Reduction Sales Co. Chairman, Meetings & Papers Committee—A. W. Fry, Chas. A. Strelinger Co.

In the near future notice will be broadcast advising the date and meeting place of the society after which a determined campaign will be launched to bring into the membership, all those in this territory who are interested in Welding and wish to improve the art and benefit themselves, by the interchange of ideas and through access to papers on the subject furnished by the Society.

NEW WELDING NECK FOR PIPE AND TANK WORK

The American Spiral Pipe Works, Chicago, Illinois, has recently put on the market a new development in flanged welding necks. These are of seamless forged steel. Each neck is forged as one piece from a steel billet. The purpose of these necks is to provide safe and convenient branch outlet for pipe and tank work, eliminating under many conditions the use of heavy cast fittings and a pair of heavy flanges.



A New Development in Flanged Welding Necks

The manufacturer calls particular attention to the fact that the tubular portion has the same inside diameter as that of extra heavy wrought pipe, while the thickness is somewhat greater. The flanged portion of the welding neck is furnished in 250 and 400 pounds standards.

CAST IRON SOLDERING

By Kut-off

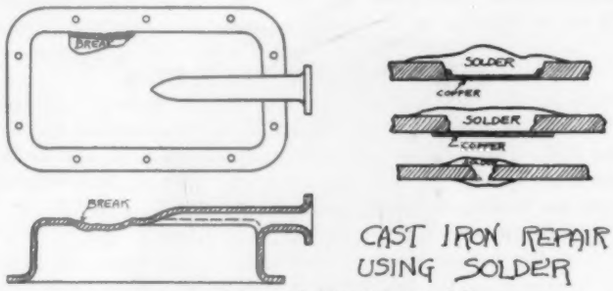
Dear Editor:

I have often wondered why it is that the amount of welding work which comes into Bill's shop changes from time to time. For instance, this week we have so much ahead of us that we are all working overtime trying to get it out. And on top of that there are emergency calls for outside work which means that some of these rush orders in the shop have to be dropped and somebody sent out to handle the outside jobs. But next week it may be altogether different and some of us will be wondering whether it won't mean a vacation until business gets better.

A few weeks ago during one of the busy spells, Bill hired an old welder who had been knocking around the country—a floater, but a corking good man who knew the game from A to Z. Before he left he showed me a little kink that came in handy and which we have used quite a few times to help ourselves and others out of trouble when we didn't have time to do a welding job and yet had to do something for a customer or lose him. Sounds simple and one that a lot of people claim they can do—but how well? Cast iron soldering, that's all. May be I ought to make up the stuff and sell it for a fancy price but it wouldn't be right when it is so easy for every welder to do it for himself, or else buy stuff made up to do the trick.

Some fellows claim they do it with raw muriatic acid; others with copper sulphate solution, but the job is never what it should be and doesn't compare with the stuff I'm telling about.

But here's how it started. A chap came in one day with his jitney bus (they have several hundred running on the streets around here) and it sure was boiling, due to low tide in the water jacket and radiator. The trouble had started when he was tightening the cylinder head on the motor block and had cracked a neat little V out of the top of the block leaving



How Cast Iron is Soldered Successfully

a gap for the water to run through. Well, he sure was out of luck as he had just lost a lot of time off the line having his bus overhauled and here he was, stuck with a damaged motor before he had even had a chance to make a trip. And he admitted he was dead broke.

The old welder I mentioned before, spoke up and called Bill to one side. I don't know just what he said but I was surprised when Bill asked the bus driver, "how would it be if we soldered the break so you could keep running as long as you kept the water in the jacket right up to the top?"

"Fine," was the reply, "but will it hold for any time? If I can only keep running for a little while, I'll get a new block all ready to put in when it goes again."

The old man answered him, "I won't guarantee the joint a minute if you try to run your car without water, or the motor overheats for some other reason, but if it runs normally it will last a mighty long time."

Well, the old fellow beat it out to the drug store and brought back some muriatic acid into which he cut a few pieces of zinc that we had around the place and let it boil until the action stopped. Then he threw in a big pinch of sal-ammoniac and stirred it up thoroughly. That wasn't new to me as I've used this mixture for soldering before this, but the funny thing occurred when he heated up a piece of clean copper until red hot and dipped it into the mixture, letting it sizzle for a short while.

"That's ready" he said, "now I'm going to clean out the crack thoroughly and fill it up with solder."

And he went to work without losing any time. After the cylinder head was off, he filed out the crack and cleaned it thoroughly. Then he applied the solution with a small piece of clean waste tied to a stick. In the meantime he had heated a soldering bit and he tinned it and rubbed it over the edges of the crack adding a little solder from a piece of ordinary half and half. It was amazing how the solder took to the cast iron. The whole job took about ten minutes. Then he filed it down, put on the cylinder head and told the driver to fill the water jacket and take the car away.

Well, that happened several weeks ago and the bus is still running, but the old boy isn't with us any more. But before he left on his "wanderlust" as he called it, he told me, "son, if you have any sort of a job on cast-iron where a piece is missing, back it up with copper, and it'll be some job." I tried it out and it works like a charm.

All you have to do is to cut the copper to fit inside the hole and then solder it to the casting. Of course, if the job requires strength, you have to weld, but if it is simply a case of appearance, or for holding oil, etc. there is no reason why the job is'nt just as good and you save preheating. I used it on a big transmission case the other day and made a job that couldn't be noticed after the paint was put on it.

Am enclosing a sketch showing one of the jobs that we are putting through that way now. We have quite a few of these that were damaged and are fixing them up for a few cents apiece, cost to us, and are saving the customer quite a little money.

Only a word of caution. The mixture must be kept clean. And clean the cast-iron surfaces thoroughly.

Kut-off.

P. S. If any welder can't make the stuff himself from my description let him write me care *The Welding Engineer* and I'll try to fix him up with some of it.

REGO RENUMBERS TIPS

The Bastian-Blessing Company, Chicago, has recently announced a revision in the numbering of that company's welding and cutting tips. This is with the intention of approaching standardization in the numbering of all tips. We print here the letter received from the Bastian-Blessing Company.

"Gentlemen:—

We believe that we have adopted a practice and a new system of tip numbering which is worthy of much consideration on the part of other manufacturers of welding and cutting torches.

We think that you can appreciate that in the past a customer using a D-B No. 10 tip had no idea, and no way of determining how that tip compared in capacity with say an Oxweld No. 15 tip or a Rego No. 3 tip. This condition has been brought about by manufacturers arbitrarily adopting a system of tip numbering which had no relation to the tip numbers of other manufacturers.

We believe that the proper method of correcting this would be to have all manufacturers adopt the practice of numbering their tips with a prefix indicating the model of torch, followed by the number indicating the drill size used in the outlet of the tip. We attach a schedule of our new tip numbers and believe that your readers would be interested in an editorial discussion of the subject.

You might in preparing an article on this interesting question, get a tabulation of the various tip numbers from the more prominent manufacturers.

We appreciate that the drill sizes do not give an exact comparison but only an approximate comparison of the heat capacities of the various tips. It is near enough, however, for the average operator and will be of considerable help to him in selecting the proper size of tip.

Very truly yours,
(Signed) E. L. Mills, Sales Mgr."

News of the Welding Trade

Chicago Eye Shield Company, 2300 Warren Avenue, Chicago, announces the completion of a contract for the Government Navy Department for welding goggles. This contract calls for 1,750 pair of goggles fitted with "Essentialite" lenses.

The Bastian-Blessing Company, Chicago, Illinois, has recently made arrangements with The Welding Equipment & Supply Company of Kankakee, Illinois, to handle Rego welding and cutting equipment. This firm also handles a complete line of welding rods and gas.

The Memphis Oxygen Company of Memphis, Tennessee, announces the installation of their second 30 meter unit Heylandt Liquifaction plant. This work is being done under the direction of Mr. E. G. Luening, with Mr. Ed Heyman in charge.

The Roller-Smith Company, 233 Broadway, New York, N. Y. announces the appointment of Mr. W. H. Pugh as its representative in the Northeastern part of Pennsylvania with headquarters at its factory at Bethlehem, Penna.

The Diehl Welding & Machine Co., Inc., 121-23 North Michigan Avenue, Atlantic City, N. J., has been incorporated to continue the business previously conducted by J. B. Diehl, general machinist and iron worker. J. B. Diehl is president and W. R. Pritchard, vice-president.

The American Association of Engineers will hold its annual convention on June 2 to 5 inclusive, at Orlando, Fla.

The Lehigh & New England has placed an order with the Pressed Steel Car Company for the conversion of 197 composite gondola cars into box cars.

The sixth sectional meeting of the American Society for Steel Treating was held at the Hotel Sinton, Cincinnati, Ohio, Thursday and Friday, January 15 and 16. The following were presented: "Sample Preparation for High-power Photomicrography," by R. G. Guthrie, metallurgist, Industrial Gas Department, Peoples Gas Light & Coke Co., Chicago, Ill.; "High Tensile Strengths with Low Carbon Steels," by R. H. Smith, vice-president, Lamson & Sessions Co., Kent, Ohio; "Wear and Wear Testing," by G. W. Quick and S. J. Rosenberg, Bureau of Standards, Washington; "Gearing as a Medium of Industrial Power Transmission," by O. N. Stone, assistant chief engineer, Van Dorn & Dutton Co., Cleveland, Ohio; "Corrosion Resisting Steels of the Iron-carbon-chromium and the Iron-carbon-chormium-silicon Series," by T. Holland Nelson, metallurgist, United Alloy Steel Corporation, Canton, Ohio.

The Gibb Welding Machines Company, under the management of Mr. C. O. Watson, announces a removal of its office from 551 West Van Buren Street, Chicago, to 1361 Peoples Gas Building, Chicago.

Mr. O. A. Benson was elected president of the National Oxygen Company, February 2, 1925. Mr. Benson succeeds Mr. H. G. Austin, who has been compelled to retire from active service on account of ill health.

The K-H Electric Welding & Sales Company of Ft. Wayne, Ind., has recently changed the name to Grimes-Hughes Company. The office will remain at 702 Tri-State Building, and the shop at 338 East Columbus Street. Grimes-Hughes Company distribute electric welders and oxy-acetylene cutting and welding equipment. Electric and oxy-acetylene cutting and welding is also done in the shops of this company.

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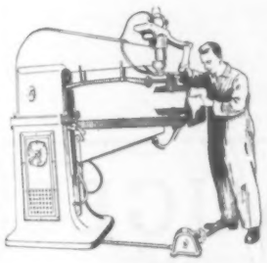

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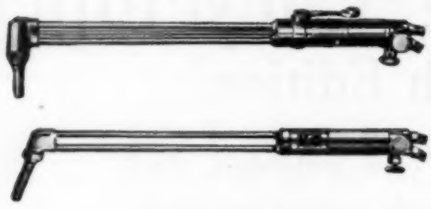

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Position Wanted—All around acetylene and electric welder, 3 years' experience in railroad work. Desires position in west. Also all around machinist. Address J. A. Harrell, P. O. Box 81, York, Alabama.

Position Wanted—High class welding expert with sales, demonstration, job shop and field experience desires permanent connection. Willing to work in any section of the country on salary and commission with contract. Address 47, care The Welding Engineer.

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British Acetylene and Welding Handbook, by a Committee of the British Acetylene and Welding Association. Contains historical and scientific data relating to acetylene, oxygen and carbide. Treatises on the application of acetylene and oxy-acetylene welding and oxy-acetylene cutting. Tests, specifications, regulations, transport conditions, etc., and also the complete reference on acetylene and acetylene welding. Bound in cloth. Price $3.00.

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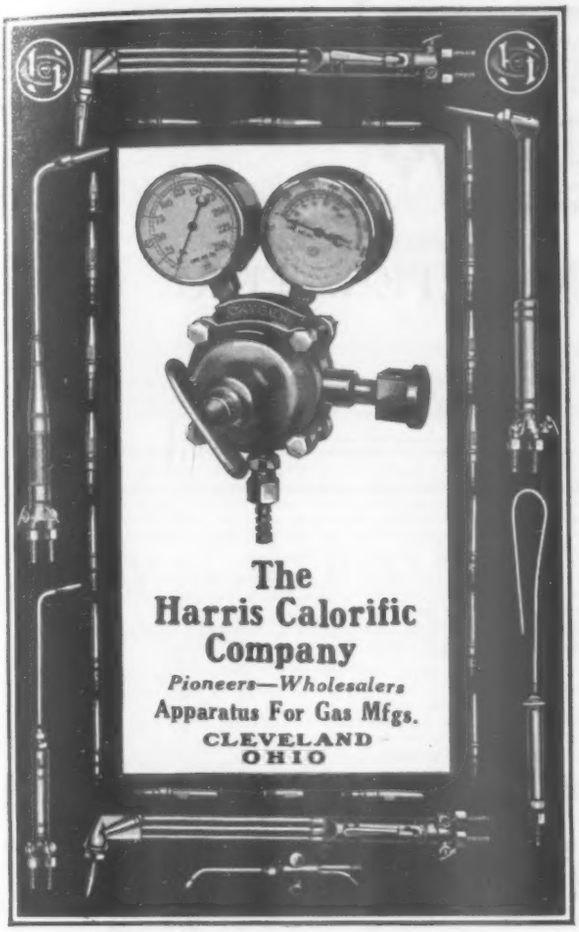

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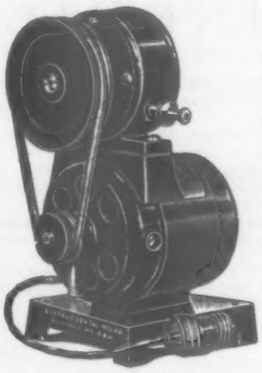

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THE USE OF FLUX IN ELECTRIC ARC WELDING, by C. J. Holslag—Article describes the different varieties of electrodes both bare and coated citing the advantages to be secured for the weld by using a flux coated electrode.—Journal of the American Welding Society, January, 1925.

WELDING AS APPLIED TO THE OIL INDUSTRY—The contents of a paper presented before the December meeting of the New York section of the American Welding Society by the Testing Department of the Standard Oil Company of New Jersey. The article enumerates the services which welding may perform in the oil industry. It also gives tests on typical welds and describes caulk welding of seams and rivets on pressure drums, storage tank welding, heavy pipe welding and the fabrication of pipe connections.—Journal of the American Welding Society, January, 1925.

MICROSTRUCTURE OF ARC WELDED CARBON STEEL, by H. H. Abram.—A paper read before the Institution of Welding Engineers, London, November, 1924. The article describes minutely the structures of carbon steel under different conditions. Micro photographs illustrate the different sections ranging from normal and tansition stages to completely welded sections.—Welding Journal, London, January, 1925.

THERMIT WELDING, by Cecil Leigh and Alfred Scott—Contents of a paper read before Institution of Welding Engineers, December, 1924. The article treats historically the introduction and growth of the thermit process. From the time of early experimentation by Goldschmidt to present day application in industry. Paper also gives a thorough description of the content and process of the thermit welding system. The article lists several examples of typical work done by the thermit process and gives data on tensile tests.—Welding Journal, London, January, 1925.

THE OXY-ACETYLENE FLAME—This article describes the correct method of securing good regulation of the flame through constant observation and re-regulation. Thoroughly deals with points to be observed in procuring proper heat without unnecessary gas consumption.—Revue de la Soudure Autogene, November, 1924.

CUTTING CAST IRON AND COPPER ALLOYS BY THE ELECTRIC ARC PROCESS, by A. G. Bissell.—This article cites advantages of the arc over older methods for reducing old cast iron and copper alloy scrap to charging box size. One inch graphite electrode tapered to ¼" point is recommended for cutting copper alloys, using very close arc with about 900 amperes. The article also gives time and power consumption in cutting typical cast iron sections.—Machinery, February, 1925.

HISTORY, MANUFACTURE AND APPLICATION OF MANGANESE STEEL, by J. H. Hall.—The author traces the growth of Manganese steel production from the time of its discovery to present date, listing the difficulties, shortcomings and advantages encountered during that time. He also describes the experience of certain manufacturers in using Manganese steel in the making of car wheels. Article lists the present day uses for 12% Manganese steel and the different methods used in making it.—Journal of the American Welding Society, January, 1925.

AN ALL WELDED BARGE, by W. L. Warner.—A description of the building of a seventy ton oil barge to be used by the Pennsylvania Petroleum Products Company. Barge was entirely arc welded and built by the Saxe Providence Boiler Works.—Journal of the American Welding Society, January, 1925.

A NEAT PIECE OF CUTTING WORK—An account of delicate acetylene cutting when worn couplings were removed from rotary drill shafts. Skillful manipulation of the blow pipe allowed this to be done without harming the threads.—Oxy-Acetylene Tips, February.

HEATING SYSTEM FOR A MODERN PLANT—A complete description of the installation of a factory heating plant in which oxy-acetylene welding played the important part. The article describes the welding of pipe coils; cutting, beveling, and welding of joints and the fabrication of pipe supports.—Oxy-Acetylene Tips, February.

APPLICATION OF THE OXY-ACETYLENE PROCESS TO REFRIGERATION PLANTS—Refrigeration plants with tanks, coils, tubes, and pipes makes fertile ground for oxy-acetylene welding and cutting. The article describes some of the heavy plate welding, cast iron head welding, welding of coils and ammonia drums, and the cutting and patterning of braces and supports.—Oxy-Acetylene Tips, February.

RAILROAD WELDING, by A. F. Dillon.—The author gives general instructions as applied to railroad welding including in his first chapter a description and definition of terms applied to autogenous welding. This is the first of a series of ten articles on autogenous welding.—Railroad Purchases and Stores, February.

OXY-ACETYLENE CUTTING AND WELDING FOR STUDENTS—The fifth of a series of lectures on fundamentals of welding, dealing with explosive hazards of combustible gases, flash backs, back fires, importance of correct procedure in oxy-acetylene welding and work room exercises in setting up apparatus.—Acetylene Journal, February.

ACETYLENE DISTRIBUTION IN MAGNOLIA PIPE LINE, by G. O. Carter—Discription of new method of supplying acetylene to pipe welding outfits in the field.—Acetylene Journal, February.

FUNDAMENTALS of ACETYLENE WELDING AND CUTTING IN THE RAILROAD CAR SHOP, by W. H. Levington—The article is a detailed discussion of the fundamentals of gas welding as applied to work in the railroad shops.—Acetylene Journal, February.

WELDING MAKES BETTER BEDS—The article describes the introduction of oxy-acetylene welding in the manufacture of metal beds, pointing to the fact that the ends are stronger than when riveted or bolted. By welding the joints in the metal furniture prevents loosening and avoids subsequent complaints.—Oxy-Acetylene Tips, February.

GENERAL ELECTRIC ISSUES MANUAL—The Arc Welding and Cutting Manual, recently issued by the General Electric Company, a 127-page volume, well bound in cloth. This has been given the designation Y-2007 and was issued "to acquaint the uninformed in a general way with some of the applications of arc welding, and to provide a simple and logical method by which one may acquire a certain familiarity with the manipulation of the electric welding arc and its characteristics."

The volume is profusely illustrated with photographs, diagrams and charts explanatory of the text. It is divided into three parts, the first devoted to general information on arc welding, the second to a training course for operators, and the third giving a number of applications of arc welding. The manual should prove very valuable in practically all industries and trades. It is being distributed at a nominal price.

STEEL CONSTRUCTION—The American Institute of Steel Construction has recently issued a seventy-two page manual, called "Steel Construction." The manual embodies a survey of the steel industry, a discussion of the importance of standardized specifications, explanation of specification formulae, a listing of standard specifications for structural steel for buildings, code of standard practice, and a tabulation of dimension functions, allowable loads, deflection, shearing and burring, and various other vital factors pertaining to steel construction.

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